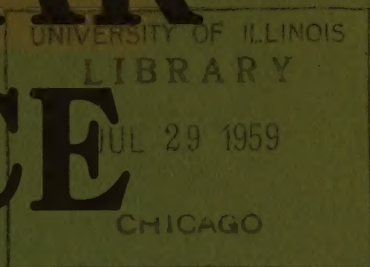


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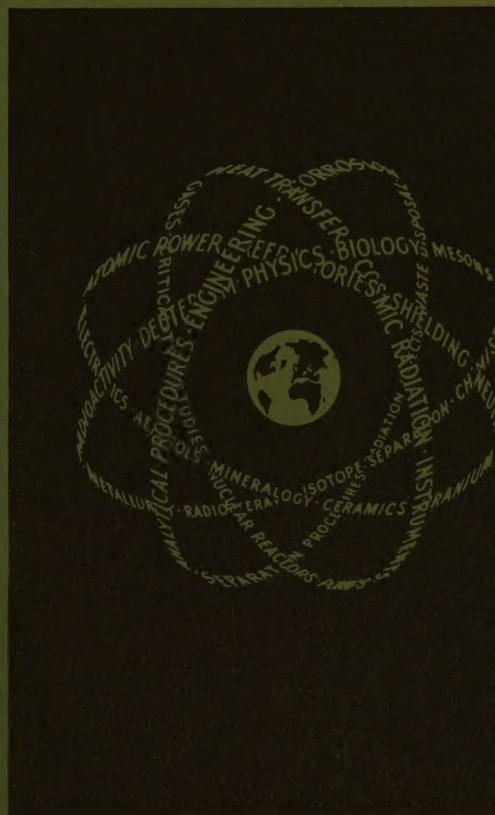
NUCLEAR SCIENCE ABSTRACTS



July 15, 1959

Volume 13 Number 13

Abstracts 11520-12326



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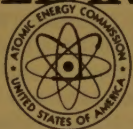
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NUCLEAR SCIENCE ABSTRACTS



Volume 13 Number 13

July 15, 1959

GENERAL

11520

AIR TIGHT BOX FOR MANIPULATION IN A CONTROLLED ATMOSPHERE. M. Rapin. *Inds. atomiques* No. 1-2, 2p.(1958). (In French)

Alpha-emitting metals must be handled in an air-tight enclosure, where a constant depression is maintained. Boxes with certain faces made of plexiglas, on which are fixed gloves for manipulations inside the box, are used for this purpose. Many devices were used for making up the framework of the box and for ensuring the solidity of the joint between this framework and the plexiglas windows. (auth)

11521

THE NATURE OF A PARTICLE OF REMARKABLY HIGH RADIOACTIVITY IN ATMOSPHERIC FALL-OUT. W. Kolb and H. D. Schulz (Physikalisch-Technische Bundesanstalt, Brunswick). *Naturwissenschaften* 46, 139-40(1959). (In German)

A particle of remarkably high radioactivity was found on a foil exposed to atmospheric fall-out for 48 hours from November 29 to December 1, 1958, in Braunschweig, Germany. The beta activity was measured as 2×10^{-10} c on December 2, and the gamma spectrum was analyzed. Well-resolved lines were detected at 80, 500, 740, and 1600 kev. These lines were assigned in sequence to the isotopes Ce^{144} , Ce^{141} , Ru^{103} , Zr^{95} , Nb^{95} , and La^{140} . (J.S.R.)

11522

INTERNATIONAL PROBLEMS OF FINANCIAL PROTECTION AGAINST NUCLEAR RISK. New York, Atomic Industrial Forum, Inc., 1959. 99p. \$6.00.

A summary of the chief legal elements of financial protection against nuclear risk is presented. In addition, the questions peculiar to the international nature of nuclear risk are considered as well as what appear to be the most promising solutions to the associated problems. Following these, detailed examination of the involved legal questions is conducted. (J.R.D.)

11523

RESEARCH HIGHLIGHTS OF THE NATIONAL BUREAU OF STANDARDS. ANNUAL REPORT, FISCAL YEAR 1958. Miscellaneous Publication 226. Washington, National Bureau of Standards, 1958. 144p. Available from U. S. Government Printing Office, Washington for \$0.45.

Accomplishments of the technical program during

fiscal 1958 are reviewed. The program was concerned primarily with the development and improvement of standards and methods of physical measurement, the precise determination of fundamental physical constants, and determinations of the basic properties of materials. Studies in the field of atomic and radiation physics included research on spectroscopy, free radical studies, the behavior of semiconductors, electron polarization, scattering of low-energy electrons, proton gyromagnetic ratio, the structure of negative ions, neutron age, the penetration of gamma radiation, x-ray studies, nuclear structure and radiation absorption, and the development of phosphor-in-plastic fast neutron detectors, a rubidium vapor magnetometer, gas radioactivity standards, and dosimeters for x and gamma radiation. A list of publications during the year is appended. (C.H.)

11524

VULNERABILITY OF A CENTRAL STATION POWER PLANT TO ATTACK BY A NUCLEAR WEAPON. David B. Singer (Illinois Inst. of Tech., Chicago). p.214-24 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

Methods for conducting a study on the vulnerability of a thermal electric power plant to air blast from an atomic weapon are discussed. Predictions of physical damage to the plant from a nominal weapon are made. Methods for reducing the vulnerability of a station to nuclear attack are described. (W.D.M.)

11525

A NEW APPROACH TO HEAT AND POWER GENERATION FROM CONTAINED NUCLEAR EXPLOSIONS. F. B. Porzel (Illinois Inst. of Tech., Chicago). p.92-102 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

The existing possibilities in peacetime applications of atomic and thermonuclear weapons for heat and power generation by control of the explosion itself are discussed. The hydrodynamic techniques are based on theoretical work and design studies done at Armour Research Foundation on explosive phenomena during the last few years. The containment of large underground explosions to small volumes and manageable pressures is discussed. (W.D.M.)

11526

NUCLEAR POWER—WHERE ARE WE HEADED IN COSTS? Leonard F. C. Reichle (Ebasco Services,

Inc., New York). p.132-41 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

Capacities and efficiencies of conventional power stations are reviewed, and a basis of competition for nuclear power is set up. Nuclear power unit costs are discussed in terms of direct, and indirect, operating, maintenance, and fuel costs. (W.D.M.)

11527

NUCLEAR POWER YEAR BOOK, 1958-1959. 2nd Edition. William Davidson, ed. London, Rowse Muir Publications, Ltd., [1959]. 570p.

The framework designed for the first edition was retained but there was a complete revision and a considerable expansion in content within this framework. Review articles on British nuclear power, instruments, fuel element design, thermonuclear research, and uranium mining prospects are presented. The isotope section contains data on 1391 nuclides. The World Authorities section was completely revised by fresh reference to the bodies concerned and now include 41 countries and seven international agencies. The Technical Data section containing chapters on reactor physics, metals, and water tables was brought up to date. Sections on company addresses, Buyer's Guide, Trade names, and Who's Who in British Nuclear Energy complete the book. (W.D.M.)

11528

NUCLEAR PROPULSION AND ENGINEERING FOR ENGINEERS. Demetrios George Samaras. Athens, The Technical Chamber of Greece, [1955]. 720p.

The fundamentals of nuclear physics and engineering from the aviation point of view are discussed. The existing information on nuclear reactors and their ramification for use in aviation is analyzed. A knowledge of the theory of differential equations and elementary statistics is assumed in the reader. The book is expected to cater to the needs of both undergraduate and graduate students and to professional engineers in different areas of technological endeavor. (W.D.M.)

11529

IMPROVEMENTS IN OR RELATING TO METHODS OF AND APPARATUS FOR DETECTING LEAKS IN APPARATUS SUCH AS HEAT EXCHANGERS. Hugh Wilson Davidson and Howard Harold Walter Losty (to General Electric Co., Ltd.). British Patent 812,198. Apr. 22, 1959.

A heat exchanger leak detector is described which uses inflatable rubber bladders. One bladder is placed inside one header and inflated to seal the tubes at that end. Another bladder, cup-shaped, seals a cup over a single tube in the other header when inflated. The cup is connected to a gas flow meter. Thus, a flow of gas indicates a leak in that tube. (T.R.H.)

BIOLOGY AND MEDICINE

11530 AECU-4024

Rochester, N. Y. Univ.

CHEMICAL METHODS FOR ROUTINE BIOASSAY.

John B. Hursh, ed. Nov. 1958. 104p. \$1.00(OTS).

Methods in routine use for bioassay of materials of interest in U.S.A.E.C. biology programs are reviewed. Selected methods are given for Pu, Po, Ra, Th, T, U, and Sr. (T.R.H.)

11531 AERE-C/R-2816

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England.

RADIOACTIVE AND NATURAL STRONTIUM IN HUMAN BONES: U. K. RESULTS FOR EARLY 1958. F. J. Bryant, E. H. Henderson, G. S. Spicer, M. S. W. Webb, and T. J. Webber. Jan. 1959. 6p. \$0.25(BIS).

Results are reported of the analyses of human bone from various places in England for Sr^{90} and natural Sr. The samples are from early 1958, and the median levels show only slight increases over corresponding 1957 samples. The highest values are again in the 0 to 5 year age group. (T.R.H.)

11532 AERE-Med/R-1848

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE TOTAL LEUCOCYTE COUNT: A COMPARISON OF THE HAEMACYTOMETER METHOD WITH THE DREYER SINTON FOWL CELL TECHNIQUE. C. Sanders, F. M. Turner, P. C. C. Long, R. Cox, and D. H. Pinnock. Jan. 20, 1956. 10p.

The need for a cheap and rapid method of making total leucocyte counts is discussed. An experiment was performed to compare the results from a modification of the Dreyer-Sinton Fowl Cell Technique with those obtained by the routine method. The Dreyer-Sinton Fowl Cell Technique was found to give a reasonably good estimate of the total leucocyte count. The advantages and disadvantages of the method are discussed. The white cell dilution pipette method using a modified hemacytometer is recommended. (auth)

11533 AF-SAM-59-4

Texas. Univ., Austin. Radiobiological Lab. PERIPHERAL CUE LEARNING SET IN RHESUS MONKEYS. A. A. McDowell and W. Lynn Brown. July 10, 1958. 4p.

Four control and nine chronic whole-body irradiated rhesus monkeys, with previous experience on standardized learning set problems and in the utilization of peripheral cues to procure food rewards, were tested on six four-trial peripheral cue learning set problems per day for 39 days. The irradiated Ss did not differ significantly from the control Ss with respect to performance on this training. There was no significant interproblem improvement in performance over the periods of testing. There was statistically significant intraproblem improvement in the performance which was consistent over the periods of testing. (auth)

11534 AF-SAM-59-22

Oak Ridge National Lab., Tenn. THE RADIOBIOLOGY OF THE CANCER CELL. A. C. Upton. Aug. 25, 1958. 22p.

Through study of the effects of ionizing radiation, fundamental information has been gained about the biology of normal and neoplastic cells and about the process of neoplasia. A variety of disturbances have been observed in irradiated cells, including alterations in metabolism, growth, and differentiation, but existing evidence suggests that the most significant primary action of radiation is on the genetic apparatus of the cell. That radiation-induced genetic effects may initiate tumor formation is highly conceivable; however, some other mechanism seems to be involved in certain instances of radiation carcinogenesis. Whatever the mechanism, the development of malignancy appears to

be a complex, multistage process. The material basis for the large variation in radiosensitivity that exists among cells of different types is still poorly understood; however, with increasing knowledge of the mode of action of radiation and of the factors influencing the radiosensitivity of the cell, ways are being found to increase, decrease, and repair radiation injury. These advances hold promise of providing means of enhancing the effectiveness of radiotherapy in the treatment of cancer and of reducing the hazard of radiation as a carcinogenic agent. (auth)

11535 AMC-TR-7-665

Cincinnati, Univ., Kettering Lab.

QUARTERLY PROGRESS REPORT ON TOXICITY OF BERYLLIUM. J. Cholak, L. H. Miller, and Frank Princi. Sept. 16, 1958. 29p. Contract AF33(600)-37211.

A review of current knowledge and experience is presented as a preliminary guide for use by individuals who have the responsibility for protecting the health of personnel engaged in operations in which Be is used. Included are descriptions of the effects of Be absorption and specific measures designed to prevent illness and maintain health among persons who work with it. A proper recognition of the hazardous potentials of this material and an understanding of the basic hygienic principles described should result in safe handling and the avoidance of illness. (auth)

11536 IGR-27(RD/W)

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

A BIOLOGICAL INVESTIGATION OF THE FATE OF STRONTIUM 90 IN A DISUSED FILTER BED. E. E. Foreman and K. W. E. Bidwell. 1959. 19p.

This is a Declassified version of IGR-TN/W-658.

Five-hundred millicuries of Sr^{90} were added to $1\frac{1}{4}$ million gallons of fresh water containing 75 ppm calcium. Biological samples were taken after 42, 133, and 272 days. High concentrations of the Sr^{90} were found in *Oedogonium* sp., *Cladophora* sp., *Myriophyllum spicatum*, plankton debris, fine particles in the water, bottom, rudd scales, gills, and bone. The flesh, skin and eyes of the rudd had low specific activities. Autoradiographic techniques were employed in locating the distribution of Sr^{90} within the tissues. The calcium/strontium ratios in some of the samples were determined by spectrographic analysis. (auth)

11537 TID-3315

Technical Information Service Extension, AEC.

RADIOISOTOPES IN ANIMAL PHYSIOLOGY.

A Selected List of References. J. A. McCormick, comp. Dec. 1958. 118p. \$2.50(OTS).

This bibliography contains 2439 references on uses of radioisotopes in metabolite physiology in animals, non-metabolite physiology in animals, injurious agent physiology in animals, and general physiology in animals. The references were selected from scientific journals published during 1948-1957. A list of the periodicals from which the references were selected and an author index are included. (auth)

11538 TID-3516

Technical Information Service, AEC.

RADIOISOTOPES IN AGRICULTURE: ANIMAL HUSBANDRY, BACTERIOLOGY, FERTILIZER UPTAKE, PLANT PHYSIOLOGY, PHOTOSYNTHESIS, AND

ENTOMOLOGY. A Selected List of References. J. A. McCormick, comp. Jan. 1959. 67p. \$1.75(OTS).

This bibliography contains 1335 selected references on uses of radioactive and stable isotopes in animal husbandry, bacteriology, fertilizer uptake by plants, plant physiology, photosynthesis, and entomology. These references were selected from scientific journals published during 1948-1957. A list of the journals from which the references were selected and an author index are included. (auth)

11539 UCRL-8668

California, Univ., Berkeley. Lawrence Radiation Lab. EFFECTS OF pH AND ANOXIA ON THE CELL MORPHOLOGY AND RADIATION SENSITIVITY OF *ESCHERICHIA COLI*. (thesis). Thornton William Sargent, III. Feb. 27, 1959. 55p. \$1.50(OTS).

The effects of varying the hydrogen ion concentration and oxygen tension in the environment of *Escherichia coli* during growth, irradiation, and post-irradiation incubation have been studied. Previous workers had found that when these cells are grown anaerobically, their resistance to x rays is greatly increased. This resistance was attributed to the production of an anoxic condition within the cell during growth, in the same way as and additive to resistance conferred by anoxic conditions during irradiation. It is shown here that protection conferred by anaerobic growth is independent of anoxia during irradiation, and can be abolished by causing growth to occur in alkaline rather than the usual acid conditions. The resistance resulting from anaerobic-acid growth is attributed to the multinucleate nature of the cells, as shown by cytological observations, DNA analysis, and the shape of survival curves. (auth)

11540 USNRDL-TR-304

Naval Radiological Defense Lab., San Francisco.

ATTEMPTS TO REPRODUCE CIRRHOSIS OF THE LIVER IN RATS FOLLOWING TOTAL-BODY

X-IRRADIATIONS. H. W. Carroll, A. P. Spivack, and R. W. Brauer. Feb. 26, 1959. 13p.

A histopathological study of the liver following whole body x irradiation was made using a low protein diet as a tool for amplifying latent injury. Experiments were designed so that rats were placed on the experimental diet before exposure, during exposure, at the end of the exposure period or after an extended period of recovery from the acute radiation illness. Whole-body x irradiation, either 475 r in a single exposure of 200 r/week for 5 consecutive weeks, had no demonstrable effect upon onset or severity of cirrhotic lesions when compared to non-irradiated rats on the same diet for the same period of time. Fibrous lesions of the liver in these experiments appear to be dietary in origin and were all but eliminated by choline supplementation. (auth)

11541

RADIATION CATARACT FOLLOWING FRACTIONATED RADIUM THERAPY IN CHILDHOOD. C. F. Qvist and B. Zachau-Christiansen (Radium Center, Copenhagen and Univ. of Copenhagen). *Acta Radiol.* 51, 207-16 (1959) Mar.

Radiation cataract is discussed in a series of 57 cases, mostly infants, treated with radium for cutaneous hemangiomas of the head during the period 1913-1933. Four were found to have developed the condition; the series included many cases of visual impairment. (auth)

11542

VARIABILITY OF RADIATION DOSE-EFFECT REGRESSIONS. Heinz Oeser and Ernst Krokowski (Free Univ. of Berlin). *Acta Radiol.* 51, 217-25(1959) Mar.

Weight changes in the optic lens of the rabbit caused by somatic radiation damage are described and discussed as demonstrating a variability of the dose-effect regression. (auth)

11543

INTEGRAL DOSE IN MOVING-BEAM IRRADIATION. Fearghus O' Foghludha (St. Luke's Hospital, Dublin). *Acta Radiol.* 51, 226-36(1959) Mar.

The variation of integral dose per unit axis dose with HVL is discussed for circumaxial rotation about homogeneous cylinders. It is shown that the integral dose per unit time to fixed depth in a beam of fixed solid angle is independent of FSD over a wide energy-range. Using this fact and an empirical relation for the variation of integral dose with body thickness, the integral dose per unit axis dose is determined for eccentric rotation about circular cylinders and for circumaxial rotation about elliptical bodies. A simple method for approximate calculation is discussed. (auth)

11544

THE INDUCTION OF MALIGNANT BONE TUMORS IN MICE BY RADIOISOTOPES. Miriam P. Finkel and Birute O. Biskis (Argonne National Lab., Lemont, Ill.). *Acta Unio Intern. contra Cancrum* 15, 99-106(1959).

Bone-seeking radioisotopes have been known to cause osteogenic sarcomas from the time that these nuclides were first available for biological research. What constitutes neoplastic change, however, and how irradiation contributes to it are still unknown. Since bone tumors can be produced in all mammals with equal facility, and since the disease appears to be the same wherever found, information obtained from the mouse is generally applicable when proper consideration is given to major differences, such as size. Radium-226, strontium-90, and calcium-45 were selected for study because they are chemically similar, all becoming incorporated in bone crystal, but are physically dissimilar, each emitting rays of different type or energy. In this way the effects of the alpha emissions of radium and the beta emissions of strontium-90 and its yttrium-90 daughter can be compared. Similar comparisons can be made of the strong beta ray of the latter (2.18 Mev) and the weak beta ray of calcium-45 (0.25 Mev). The relative contributions of the high dose-rate present for a short period of time immediately after injection and the low dose-rate present for a long period of time are evaluated by the use of single and fractionated doses of radio-strontium. This technique also may furnish information pertinent to problems of carcinogenic potency in relation to uniformity of distribution of the isotope. The results examined for evidence of differences associated with the above variables are tumor location and pathologic type, latent period, and tumor incidence rate, and probability as a function of dose. In addition, the shapes of the dose-response curves are characterized, and data concerning the presence or absence of a threshold for tumor induction are presented. (auth)

11545

CARCINOGENESIS IN IRRADIATED PARABIOTIC RATS. Shields Warren (New England Deaconess Hospital, Boston). *Acta Unio Intern. contra Cancrum* 15, 242-5(1959).

Sionaker strain rats are parabiosed and after physio-

logical equilibrium has been approached, one of the pair is given 100 r of 400 kv x radiation in a single dose. A wide variety of tumors have appeared after an interval of months to years, chiefly in the irradiated member of the pair including not only the more usual tumors encountered in this strain but also such tumors as osteogenic and other mesenchymal sarcomas. (auth)

11546

TIME-INTENSITY FACTORS IN RADIATION RESPONSE. II. SOME GENETIC FACTORS IN BRAIN DAMAGE. Samuel P. Hicks, Kenneth A. Wright, and Constance J. d'Amato (New England Deaconess Hospital, Boston; Harvard Medical School, Boston; and Massachusetts Inst. of Tech., Cambridge). *A.M.A. Arch. Pathol.* 66, 394-402(1958) Oct.

One-hundred male and female mice, 25 each of four strains; DBA/2, DBA/1, LAF₁, and C57, 3 to 5 months old, were exposed to 30,000 rad of 3-Mev x radiation in one second. Animals that survived more than 24 hours were autopsied, and microscopic study of the brain was carried out. The results are discussed with respect to differences among strains, demarcated lesions, and genetic patterns of brain metabolism and radiation damage. (T.R.H.)

11547

EFFECTS OF PRENATAL X-IRRADIATION ON TESTICULAR FUNCTION AND MORPHOLOGY IN THE RAT. Benjamin H. Ershoff (Western Biological Labs., Culver City, Calif.). *Am. J. Physiol.* 196, 896-8(1959) Apr.

Present findings confirm and extend the observations of Kosaka and Hanson that x irradiation during certain stages of prenatal development results in testicular injury and infertility in the male rat. The effects were particularly marked in the offspring of rats irradiated on the 18th day of pregnancy. These rats also showed in addition to testes injury a significant reduction in seminal vesicle weight. Testicular injury also occurred in the offspring of rats irradiated on the 14th day of pregnancy but was less marked than in the 18-day series. No abnormalities in testicular function or morphology were observed in the offspring of rats irradiated on the 10th day of pregnancy. The present investigation was conducted with doses of x-irradiation that were more clearly defined, with time of irradiation more clearly delineated, and with a larger number of animals per group than was the case in earlier studies. (auth)

11548

THE EFFECT OF IONIZING RADIATIONS ON CAPILLARY SPROUTING AND VASCULAR REMODELLING IN THE REGENERATING REPAIR BLASTEMA OBSERVED IN THE RABBIT EAR CHAMBER. H. A. S. van den Brenk (Cancer Inst. Board, Melbourne). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 81, 859-84(1959) May.

The morphologic characteristics of regenerating blood capillaries (sprouting, budding and looping) are described as observed in the living state in rabbit ear chambers. The effects of ionizing radiations (gamma rays from Co⁶⁰ and 200 kv roentgen rays) on capillary regeneration are described and illustrated. Attention is drawn to the indirect effects of fibrillogenesis ("fibrous barrier formation") on capillary regeneration and remodelling in both irradiated and nonirradiated tissues. Fibrillogenesis inhibits vascular regeneration and modifies morphologic ap-

pearances, despite an intrinsic competence for growth of the irradiated vascular component. The morphologic events which follow irradiation of growing repair tissues to high dosage and result in cessation of growth and in the formation of a "fibrous barrier" are described and illustrated. The phenomenon, which has been termed "super-regeneration," is described and illustrated. This phenomenon shows that the intrinsic competence for growth of irradiated endothelium remains essentially intact despite cessation of such growth in a repair blastema, irradiated to a sufficient (threshold) level of dosage. The implications of these findings are discussed in relation to radionecrosis, radiosensitivity of cell systems and the comparisons to be drawn from growth of simple cell systems *in vitro* in respect to integrated growth *in vivo*. (auth)

11549

USE OF CARBON ARC AND BURNING MAGNESIUM AS THERMAL SOURCES FOR EXPERIMENTAL BURNS. Thomas P. Davis and Herman E. Pearse (Univ. of Rochester, N. Y.). *Ann. Surg.* 149, 68-76(1959) Jan.

A carbon arc furnace for small burns and the burning of Mg flash powder for large burns are described. A 24-in. searchlight adapted for this purpose is described. The optical system is increased in size by using 60-in. mirrors, increasing the radiant power obtainable to 90 cal/cm²-sec. Exposure is controlled by rate of traverse of the animal on a car through the focus. A magnesium-burning laboratory is described. The burning time is controlled by the amount of oxidizer in the blend which is obtained ready-mixed for exposure times of 0.3 to 2.0 sec. The advantages and quality of these sources are discussed. (T.R.H.)

11550

DIFFUSIBLE TOXIC COMPOUNDS IN RADIATION DAMAGE IN PLANTS. M. I. Pushkareva (Lomonosov State Univ., Moscow). *Biophysics (USSR) (English Translation)* 3, 430-7(1958).

The preliminary experiments showed that x irradiation of bean root tips took 2 to 3 days to produce a macroscopically observable decrease in growth rate. Whether the effect was reversible or not depended on the dose. Co⁶⁰ γ irradiation of dry seeds and seedlings of cucumbers, beans, hemp, and sunflower produced a reduction in root-hair and stem length varying exponentially with dose; the slope of the dose curve was greatest at 500 to 5000 r for 1 day old seedlings, and 1000 to 10,000 r for dry seeds. The sensitivity to Co⁶⁰ γ rays also varied exponentially as a function of soaking time. The conclusions from the experiments on the indirect effects of radiation (i.e. on substances produced by irradiation) are given. No biologically active substances were observed to be transferred between irradiated and normal bean seedlings grown in succession in the same water. No such substances were found in water extracts of irradiated seedlings either. Normal seedlings were not affected by being grown side by side with irradiated ones. Narrow-beam x irradiation of the central root areas in bean seedlings did not affect the over-all lengths of the roots 6 to 7 days later, but the stems were somewhat shortened. The destruction of growth stimulants by irradiation was confirmed. (auth)

11551

INCREASES OF DRY WEIGHT IN WHEAT LEAVES AFTER X-IRRADIATION. I. M. Vasil'ev and

Tsin Su-Iun (Inst. of Biophysics, Academy of Sciences of the U.S.S.R., Moscow). *Biophysics (USSR) (English Translation)* 3, 437-40(1958).

The dry weights of type 599 winter wheat leaves irradiated at 500, 1000, 3000, 5000, and 10,000 r at 4 days old were determined. The dry weights increased with the growth depression. Above the dose producing complete depression there was no further effect. The dry weights increased with the time the plants were allowed to stand in the light, particularly in the plants in which growth was completely suppressed. The increase is assigned to the accumulation of materials normally utilized in growth. (auth)

11552

DEVELOPMENT OF SOFT WHEAT SEEDLINGS FROM THERMAL-NEUTRON IRRADIATED SEEDS. V. V. Khovostova, N. L. Delone, O. N. Sorokina, V. L. Turkov, S. P. Tselishchev, and K. V. Chaikina (Inst. of Biophysics, Academy of Sciences of the U.S.S.R., Moscow and Timiryazev Agricultural Academy, Moscow). *Biophysics (USSR) (English Translation)* 3, 440-5(1958).

Nuclear damage caused by ionizing radiation plays a decisive part in retarding growth in seedlings. Cells die at two stages, namely early, at interphase, as mitosis begins and late, due to disturbances in the chromosome balance. (auth)

11553

THE ACTION OF IONIZING RADIATION ON CELL DIVISION: AN INVESTIGATION OF LOCAL AND REMOTE EFFECTS. I. M. Shapiro (Severtsov Inst. of Animal Morphology, Moscow). *Biophysics (USSR) (English Translation)* 3, 446-53(1958).

X rays have both a local and distant action on the process of cell division. The local effect appears as: a sharp fall in the number of mitoses in the first hours after irradiation; the appearance of cells with chromosomal aberration; the absence of relationship between the effect of radiation and the dimensions of the area of the body irradiated at one time. The distant action: leads to a less pronounced depression of mitotic activity which appears later; does not cause the appearance of chromosomal aberration; has an effect which depends on the volume of body tissue irradiated. In experiments on parabiotically joined mice it has been shown that the distant action of radiation on cell division is effected by means of factors which circulate in the blood. It was found that the halving of the concentration of the mitosis-suppressing factors in the blood of the parabionts leads to a reduction by approximately one half in the distant effect. (auth)

11554

A COMPARISON OF THE EFFECTS OF α - AND β -RAYS ON MICRO-ORGANISMS. E. N. Sokurova (Urals Branch of the Academy of Sciences of U.S.S.R., Sverdlovsk). *Biophysics (USSR) (English Translation)* 3, 453-7(1958).

The results show that α particles depressed the development of bacteria much more than did β particles. This agrees with published data. When Po²¹⁰ was used at concentrations such as to give doses equivalent to those producing stimulation with β rays, it greatly depressed the development of root-nodule bacteria and Azotobacter. A mixed α and β emitter (Ra) gave an intermediate effect; it can stimulate somewhat after depressing development more or less strongly. Energy production and nitrogen fixation were more sensitive to α rays than to β rays. (auth)

11555

THE X- AND $Po\alpha$ -IRRADIATION DOSE CURVES FOR *B. COLI COMMUNIS*. Ia. L. Shekhtman, V. I. Plokhoi, and G. V. Filippova (Inst. of Biophysics, Academy of Sciences of the U.S.S.R., Moscow). *Biophysics (USSR) (English Translation)* 3, 458-64(1958).

B. coli cultures from meat-peptone agar containing 2% glucose showed cells 2.6 times as long (18 times as large) as normal. The survival curves with x rays and $Po\alpha$ rays were S-shaped for the glucose cultures, which agreed with the classical target theory. The properties of the glucose culture were not inherited, and the culture returned to normal after subculturing once on normal meat-peptone agar. The dose curves are interpreted in terms of a theory of the differing rôles of nucleoproteins and cytoplasmic proteins. The curve found with the glucose culture is interpreted as arising from the superposition of nuclear and cytoplasmic effects. (auth)

11556

THE EFFECTS OF γ -RAYS ON THE ABSORPTION SPECTRA OF PYRIMIDINE AND PURINE BASES, AND OF NUCLEIC ACIDS. T. N. Rysina and R. E. Libinon. *Biophysics (USSR) (English Translation)* 3, 464-9(1958).

Doses of from 1000 to 200,000 r of Co^{60} γ rays reduce the ultra-violet absorption of the biologically most important purines and pyrimidines, and also of the nucleic acids, partly at the lower concentrations (5×10^{-6} to 10^{-4} M). The loss in optical density increases with the γ ray dose. Additional groups attached to the purine or pyrimidine rings decrease the radio-sensitivities. (auth)

11557

THE DOSIMETRY OF IONIZING RADIATIONS OF FINITE RANGE. S. N. Ardashnikov and N. S. Chetverikov (Ministry of Health, R.S.F.S.R., Moscow). *Biophysics (USSR) (English Translation)* 3, 469-90 (1958).

A method for calculating the integral absorbed beta dose is presented in which the finite range of the particles is allowed for. In essence it amounts to replacing the normal dose calculation by the calculation of the total range of the particles in the object. Its particular advantage is the comparatively simple and direct way this is done. (T.R.H.)

11558

CHANGES IN THE MITOTIC ACTIVITY OF THE ROOT MERISTEM OF WHEAT SEEDLINGS AFTER IRRADIATION WITH X-RAYS. R. G. Trudova and Ia. L. Shekhtman (Inst. of Plant Physiology, Academy of Sciences of the U.S.S.R., Moscow and Inst. of Biophysics, Academy of Sciences of the U.S.S.R., Moscow). *Biophysics (USSR) (English Translation)* 3, 493-9(1958).

During the action of radiation on mitotic activity in 48 hr wheat seedlings three phases of reaction were observed: a rapid fall in the number of divisions in the first hour after irradiation; a phase of absence of division; a phase of recovery. Maximum suppression of the number of mitoses and the onset of recovery of mitosis appeared 5 hr after irradiation, which indicated a low rate of recovery of these processes in the roots of wheat seedlings. These findings are in agreement with the results of the investigations in which it was shown that the "time factor" during irradiation of wheat seedlings appears only in cases where the duration of irradiation is not less than 4 to 6 hr. (auth)

11559

THE RADIOBIOLOGICAL EFFECT OF INTERRUPTED IRRADIATION BY X-RAYS. A. A. Zotikov (Inst. of Biophysics, Academy of Sciences of the U.S.S.R., Moscow). *Biophysics (USSR) (English Translation)* 3, 499-502(1958).

During the action of interrupted irradiation with x rays on wheat shoots, changes in the frequency of interruption from 1 to 60,000 per min with a ratio of 1:1 between the "light" and "dark" intervals (the duration of the interval being from 30 sec to 0.5 msec) did not appreciably affect the inhibition of root growth. In comparing brief and prolonged irradiation, the "time factor" begins to influence the effect when the time of irradiation is increased to 4 to 7 hr, which is in agreement with the results of investigation of the permeability of wheat roots and the mitotic activity after irradiation. (auth)

11560

ATTEMPTS TO PRODUCE SPATIAL AVOIDANCE AS A RESULT OF EXPOSURE TO X RADIATION. Fred H. Rohles (Wright Patterson Air Force Base, Ohio) and John E. Overall and W. Lynn Brown (Univ. of Texas, Austin). *Brit. J. Radiol.* 32, 244-6(1959) Apr.

Three experiments were undertaken in an effort to repeat the spatial conditioned avoidance reported. No evidence of conditioned avoidance to stimuli present during radiation exposure was observed. It is concluded that spatial avoidance in the rat, if it does result from exposure to radiation, is confined to such a narrow range of conditions as to render it unimportant for practical consideration. (auth)

11561

MEASUREMENTS OF SUPERFICIAL ABSORBED DOSE WITH 2 MV X RAYS USED AT GLANCING ANGLES. H. A. Hughes (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). *Brit. J. Radiol.* 32, 255-8 (1959) Apr.

A photographic film method of investigating the variation of absorbed dose near an air-tissue interface is described, which involves the use of a microdensitometer. The corrections necessary to allow for the effect of direct photon absorption in the film are discussed. Application of the method to a situation in which the angle of incidence of the x-ray beam varies from 0 to 180° shows that at 2Mv the 80 per cent depth varies from 0.15 to 1.1 mm below the surface. It is suggested that this allows adequate treatment of superficial tissue, while retaining some degree of skin saving even when the angle of incidence to the normal is 90 deg. (auth)

11562

THE INFLUENCE OF X IRRADIATION ON THE IODIDE-TRAPPING MECHANISM OF THE HUMAN PAROTID GLAND. Hassan K. Awwad (Alexandria Univ., Egypt). *Brit. J. Radiol.* 32, 259-62(1959) Apr.

The influence of x rays on the radioiodine trapping function was studied in 20 patients. X-ray doses up to 3,500 r in 32 days did not influence the iodide plasma clearance rate. The S/P radioiodine concentration ratio was elevated and the saliva flow rate diminished. The observed effects seem to be related to the reduction of the amount of fluid secreted by parotid cells or parts of cells, not concerned with iodide secretion. (auth)

11563

LEUKAEMIA FOLLOWING IRRADIATION FOR ANKYLOSING SPONDYLITIS. A. G. S. Cooper and A. W. Steinbeck (Brisbane Hospital). *Brit. J. Radiol.* **32**, 266-8(1959) Apr.

A case history is given in which leukemia occurred after radiotherapy for ankylosing spondylitis. The patient received 5 courses of irradiation over 5 years, and 7 years lapsed before evidence of leukemia appeared. (T.R.H.)

11564

EFFECT OF HYPOTHYROIDISM AND THYROID GRAFTS ON LYMPHOID TUMOR DEVELOPMENT IN IRRADIATED C57BL MICE. C. Susan Nagareda and Henry S. Kaplan (Stanford Univ. School of Medicine, Calif.). *Cancer Research* **19**, 292-6(1959) Apr.

Studies on the effect of radiothyroidectomy and thyroid grafts on the incidence of thymic implant lymphomas in thymectomized-irradiated C57BL mice are reported. Hypothyroidism significantly inhibited thymic implant tumor development in females. A similar reduction of lymphoma incidence in hypothyroid males was not statistically significant. When thyroid activity was restored by grafting normal thyroids to radiothyroidectomized animals, lymphoma incidence returned to the level seen in euthyroid animals. I^{131} uptake measurements were made on a representative number of thyroids and thyroid grafts. There was no significant uptake by the I^{131} -treated thyroids. Thyroid grafts were just as active as thyroids from control animals. Body weight decreased significantly in hypothyroid animals and was restored to control euthyroid levels in radiothyroidectomized animals by thyroid grafts. The possible influence of secondary nutritional and endocrine disturbances on leukemogenesis are discussed; it seems likely that the observed inhibition is attributable to hypothyroidism per se, rather than to secondary influences on nutrition or other endocrine imbalances. Incidental observations on pituitary tumor development in lymphoma-free radiothyroidectomized animals are also reported. Pituitary tumor development was completely prevented by thyroid grafts after radiothyroidectomy. (auth)

11565

SOME APPLICATIONS OF TISSUE CULTURE METHODS TO RADIATION RESEARCH. Robert E. Bases (National Cancer Inst., Bethesda, Md.). *Cancer Research* **19**, 311-15(1959) Apr.

Results obtained in the application of tissue culture methods to two problems in radiation research are described. The problem of radiation resistance has been investigated by single-cell techniques. A method for detecting materials which can alter the radiation response of mammalian cells was illustrated by tests of two chemicals—aminoethylisothluronium bromide hydrobromide (AET) and 6-mercaptopurine (6-MP). (auth)

11566

STUDIES ON RADIATION-INDUCED LEUKEMIA IN MICE. Ludwik Gross, Bernard Roswit, Eleanor R. Mada, Yolande Dreyfuss, and Lorraine A. Moore (Veterans Administration Hospital, Bronx, N. Y.). *Cancer Research* **19**, 316-20(1959) Apr.

Fractionated total-body x radiation of young adult mice of C3H, C57BR/cd, A, and I strains induced

leukemia in up to 77 per cent of the irradiated mice after a latency varying from 5 to 6 months. Fractionated total-body irradiation of mice of the high-leukemic Ak strain had practically no effect on the incidence of spontaneous leukemia. A group of C3H mice were inoculated when newborn with Ak or C3H leukemic filtrates and then irradiated. The incidence of leukemia in this group was 43 per cent, as compared with 33 per cent in the litter-mate control group which received only the inoculation of the agent. (auth)

11567

TEST OF THE TREATMENT OF CONTAMINATION BY RADIOACTIVE STRONTIUM WITH POTASSIUM RHODIZONATE. Georges Michon and Marie-Josephe Guilloux. *Compt. rend.* **248**, 2039-41(1959) Apr. 1. (In French)

Potassium rhodizionate, by oral administration, is capable of blocking the digestive absorption of Sr^{90} in the rat. The skeleton of rats treated has a radioactivity varying from 25 to 50% of that of the skeleton of controls. (tr-auth)

11568

STUDY OF IODINE METABOLISM BY AN "ISOTOPIC EQUILIBRIUM" METHOD: DETERMINATION OF THE IODISED FRACTIONS IN DIFFERENT PHYSIOLOGICAL STATES. Cl. Simon and F. Morel (Commissariat à l'Énergie Atomique, Paris). *Compt. rend. soc. biol.* **151**, 1311-14(1957). (In French)

By means of a prolonged administration, over a period of several weeks, of a constant amount of iodide labelled with I^{131} of known specific radioactivity, the stable iodine in the organism can be progressively replaced by the labelled iodine administered; after 4 or 5 weeks "isotopic equilibrium" is effectively reached. From then on, by measuring the radioactivity of the different iodized fractions of the plasma and the thyroid (after chemical separation in the presence of carriers), the absolute quantity of iodine contained in these fractions can be calculated. The total iodine, the iodide and the organic iodine of the plasma and thyroid were measured in rats by this method as a function of the iodide content of the diet, as well as under the influence of an anti-thyroid agent. (auth)

11569

MEASUREMENT OF NATURAL RADIOACTIVITY IN HUMAN ORGANS. L. G. Shakhidzhanyan, D. G. Fleishman, V. V. Glazunov, V. G. Leont'ev, and V. P. Nesterov (Sechenov Inst. Physiological Evolution, Academy of Sciences, U.S.S.R.). *Doklady Akad. Nauk S.S.S.R.* **125**, 208-9(1959) Mar. 1. (In Russian)

Data are presented on the natural radioactivity of human organs determined by measuring the radioactivity of ashes. The natural activity of various organs (β radiation) is tabulated. The results show that the general β activity exceeds the β activity induced by K^{40} about 20 to 30% and in some cases up to 70 to 80%. The γ activity of some organs measured with a γ -scintillation spectrometer showed that additional radioactivity was generally induced by Cs^{137} from fall-out entering the body following the chain of contamination: land-plants-animals-man. The data also show that the contamination reaches all the organs and tissues in humans. (R.V.J.)

11570

METABOLISM OF RADIOACTIVE ISOTOPES WHICH DEPOSIT MAINLY IN THE SKELETON. Betsy J.

Stover (Univ. of Utah, Salt Lake City). *Health Phys.* **1**, 373-8(1959) Mar.

Of the 102 known chemical elements more than half of them have been shown or can be predicted to deposit in the skeleton to a significant extent. These elements fall into three categories: the natural constituents of the skeleton, the elements which are chemically similar, and those which have no physiological analogs and which are generally characterized by low solubility at the physiological range of pH. Fortunately not all of these fifty to sixty elements are of importance in the problem of radiotoxicity, for nuclear properties eliminate some of them. The long-lived radioactive isotopes Ra^{226} and Pu^{239} , both of which decay by α -emission, have been extensively studied in beagle dogs. Ra^{226} is chemically similar to calcium, a major constituent of bone, while Pu^{239} has no physiological analog. The metabolism of the two isotopes following intravenous injection is compared from a chemical and a dosimetric point of view. (auth)

11571

EXTERNAL β -DOSES FROM RADIOACTIVE FALLOUT. G. M. Dunning (U. S. Atomic Energy Commission, Washington, D. C.). *Health Phys.* **1**, 379-89(1959) Mar.

Information is presented on external β -radiation doses from fall-out material, and some evaluation of the biological hazard is made. A brief review is given of past laboratory data on external radiation exposures and their effects upon the skin. Consideration is given to estimating potential external β -doses from fallout based on field data and theoretical calculations. Instrument evaluation for β -monitoring is touched upon briefly. Lastly, some suggestions are proposed as guides in developing radiological safety criteria for external β -irradiation from fall-out material. (auth)

11572

THE CONCENTRATION AND DISTRIBUTION OF RADIUM IN THE NORMAL HUMAN SKELETON. A. Walton, R. Kologrivov, and J. L. Kulp (Columbia Univ., New York). *Health Phys.* **1**, 409-16(1959) Mar.

Maximum permissible levels of irradiation to the human body have been assigned from experience gained in the past with radium poisoning cases. Previous data on normal levels of radium concentration in the body are limited and show a wide variation. A comprehensive study of radium levels in the human skeleton has been made in this work using a larger number of samples. The radium concentration in different bones within the skeleton has been measured and shows a range of less than ± 15 per cent of the mean. In an urban population such as New York City the distribution of radium levels has been found to be log-normal. The average radium concentration from many localities scattered about the world is about 1×10^{-14} g Ra/g ash. The total range of all localities is from 0.3 to 3.0×10^{-14} g Ra/g ash. These levels of radium-226 concentrations are approximately 1/3000 of the m.p.c. for this isotope. (auth)

11573

RADIATION AGING AND ITS RELATION TO THE PRINCIPLES OF HEALTH PHYSICS. H. P. Yockey (Oak Ridge National Lab., Tenn.). *Health Phys.* **1**, 417-26(1959) Mar.

The principles on which health physics is based are essentially those adopted in the 1920's. These principles have not been re-examined, although the advent of reactor and nuclear weapons technology has changed the scale of the radiation exposure problem by many orders

of magnitude. Since radiation exposure is a problem of all human populations and since the consequences of environmental hazards are viewed in a different light by different cultures, it is necessary to make a clear distinction between questions of jurisprudence and questions of science. A review of some theories of radiation damage shows that a common feature is that the several aspects or manifestations can be subsumed under radiological aging. A number of authors have reached this conclusion from a pathological examination of tissues. There is now no well defined measure of what is meant by radiation damage; it is suggested that the amount of life shortening may serve as such a measure. Such a definition is scientifically correct and would be understood by executives, legislators, and the public. The logical structure of the principles of health physics is greatly improved by this definition. (auth)

11574

ON THE USE OF THE DARK FIELD CONDENSER FOR THE MICROPHOTOGRAPHS OF BIOLOGICAL AUTORADIOGRAPHS. F. Ludwig (Commissariat à l'Énergie Atomique, Paris). *Intern. J. Appl. Radiation and Isotopes* **3**, 13-14(1958). (In French)

A method is described for the preparation of microphotographs of highly magnified autoradiographs. This method is based on a superposition of two successive photographs on the same emulsion. The appearance of a halo is prevented by superposition of two images of opposite contrast. (auth)

11575

THE EFFECT OF WHOLE-BODY X IRRADIATION ON THE BACTERICIDAL ACTIVITY OF PHAGOCYtic CELLS. II. SURVIVAL OF *PSEUDOMONAS AERUGINOSA* WITHIN LIVERS AND SPLEENS OF MICE. Eric L. Nelson and Joan R. Becker (Univ. of Chicago). *J. Infectious Diseases* **104**, 20-3(1959) Jan.-Feb.

Mice irradiated five days previously with doses of 0, 100, 300, 500, and 700 r were injected intravenously with *Pseudomonas aeruginosa*. Immediately thereafter, an antibiotic was also injected intravenously to kill extracellular bacteria. Livers and spleens were removed from the infected mice 0, 4, and 24 hours later, ground, and the total numbers of viable bacteria determined by culture methods. The results indicate that the bacteria survived and multiplied within the spleens and livers of mice receiving 500 to 700 r X radiation but were destroyed in the organs of normal mice and mice receiving the lower doses of X irradiation (100 to 300 r). In mice previously immunized with killed *Pseudomonas* the bacteria did not survive within the livers and spleens even though the animals were subjected to 500 to 700 r. (auth)

11576

FURTHER INVESTIGATIONS OF THE CHEMOTHERAPY OF RADIATION SICKNESS IN EXPERIMENTS ON MONKEYS. M. A. Tumanian (Gamaleia Inst. of Epidemiology and Microbiology, Academy of Medical Sciences of the U.S.S.R.). *J. Microbiol. Epidemiol. Immunobiol. (USSR) (English Translation)* **29**, 1015-21 (1959).

The rational use of chemotherapy in the treatment of radiation sickness prevents the development of post-radiational bacteremia and the transformation of a latent chronic dysentery in monkeys into a clinically apparent acute form of the disease. Chemotherapy has a favorable effect on the outcome of radiation sickness in monkeys, preserving the lives of a large proportion

of the animals even when exposed to an absolute lethal dose of x rays. Streptomycin in the principal therapeutic program suggested for radiation sickness can be replaced by other antibiotics, albomycin and colimycin, or by the sulfonamide drug phthalylsulfathiazole. (auth)

11577

TRANSPLANTABLE CHLOROMYELOID-LEUKEMIA IN SPRAGUE-DAWLEY RATS FOLLOWING INJECTION OF ACTINIUM-227. Robert E. Zipf, Lois Chiles, Marietta Miller, and Bernard J. Katchman (Miami Valley Hospital, Dayton, Ohio). *J. Natl. Cancer Inst.* **22**, 669-83 (1959) Apr.

Chloroleukemia in the Sprague-Dawley rat presumably initiated by actinium-227 (actinium-equilibrium mixture) has been successfully transplanted in suckling rats over a period of 4 years. The morphologic and anatomic characteristics are described and found to be similar to those induced by methylcholanthrene. The successful transfer of the chloroleukemia in suckling rats was accomplished with an intraperitoneal injection of 0.1 to 0.2 ml. of leukemic whole blood without any detectable changes, after 4 years of transplantation, in either morphologic and anatomic properties or the lifespan of the leukemic animal. The chloroleukemia was also successfully transplanted in suckling rats by injection of tissue homogenates obtained from leukemic rats. The longevity of the animals injected with successful transplants appears to be a function of the number of myelocytes injected. This fact plus our inability to obtain successful transplants of the chloroleukemia with cell-free extracts leads us to conclude that leukemogenesis occurs most likely through a process of colonization. (auth)

11578

CAESIUM-137 IN DRIED MILK. D. V. Booker (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nature* **183**, 921-4(1959) Apr. 4.

Measurements of the cesium-137/potassium ratio in dried milk and some corresponding results for hay have been obtained for the period 1957 and the first half of 1958. In dried milk from Driffield, which has a relatively low rainfall, the ratio in the summer of 1957 was 25 to 30 $\mu\text{C/g}$ of cesium-137 per g of potassium, and dropped to 10 to 15 $\mu\text{C/g}$ in the winter. Dried milk from Carmarthen, a high-rainfall area, showed ratios of 60 to 70 $\mu\text{C/g}$ and about 40 $\mu\text{C/g}$ in summer and winter, respectively. The decrease in the ratio in the winter may be due to the change in feeding habits of cows, which are given supplementary food in winter. A large increase in the ratios in dried milk from all areas was observed in June 1958 and is associated with a larger than usual rate of fall-out in May 1958 and subsequent months. The average cesium-137/potassium ratio in dried milk in $\mu\text{C/g}$ for the period April 1957-April 1958 is shown to be numerically equal to the average annual rainfall in inches in the area from which the milk was collected. The effect of the Windscale accident on the cesium-137/potassium ratio in dried milk is shown to have been temporary. The cesium-137/potassium ratio in human beings in late 1957 was about the same as that in dried milk from an area having a similar rainfall. (auth)

11579

RADIOACTIVITY OF SOILS, PLANT ASHES AND ANIMAL BONES. Ernest Marsden (Royal Cancer Hospital, London). *Nature* **183**, 924-5(1959) Apr. 4.

Alpha-activity measurements were made of bones of a New Zealand cow and ewe and their offspring. Also some observations on the influence of superphosphate on plant and animal uptake of radioactivity are made. (T.R.H.)

11580

OXYGEN DEFICIENCY AND RADIATION DAMAGE IN THE INSECT RHODNIUS. W. F. Baldwin and T. N. Salthouse (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Nature* **183**, 974(1959) Apr. 4.

Unfed fourth instar *Rhodnius prolixus* nymphs were held in either N_2 or air and irradiated, then fed, and returned to a normal incubator. The delay in molting in N_2 was barely perceptible but was quite large for an equal dose in air. Burns did not develop in N_2 for doses below 120 kr, but were invariably present for 60 kr in air. (T.R.H.)

11581

A SURVIVAL CURVE FOR MAMMALIAN CELLS IRRADIATED *IN VIVO*. H. B. Hewitt and C. W. Wilson (Westminster Hospital School of Medicine, London). *Nature* **183**, 1060-1(1959) Apr. 11.

Experiments are described from which a plot of log survival rate versus cobalt-60 radiation dose resulted for CBA leukemia cells irradiated *in vivo*. A straight line was drawn through experimental points, indicating a D_0 value (dose required to reduce the reproductively intact leukemia cells to 37%) of 162 r. (T.R.H.)

11582

CAESIUM-137 IN SWEDISH MILK AND SOIL. K. Löw and K. Edvarson (Research Inst. of National Defence, Stockholm). *Nature* **183**, 1104-6(1959) Apr. 18.

Gamma spectrometric analysis results are given for milk from mid-Sweden and soils from various locations. One dried milk sample was 1947, the others were 1955 to 1958. The soil samples were collected in summer 1957 from three depths: 0 to 2.5 cm, 2.5 to 5.0 cm, and 5.0 to 10 cm. (T.R.H.)

11583

PRODUCTION OF STERILITY IN MICE BY DEUTERIUM OXIDE. Ann M. Hughes, Edward L. Bennett, and Melvin Calvin (Univ. of California, Berkeley). *Proc. Natl. Acad. Sci. U. S.* **45**, 581-6(1959) Apr.

Some of the conditions required to produce sterility in male mice by D_2O were investigated. Sterility can be produced in C_{57} male mice by substitution of 30% D_2O for normal water in the drinking water for two weeks. The mice become sterile four weeks after the initial treatment with D_2O , and in this experiment two weeks after normal water has again been provided in the drinking water. By this and other experiments the sensitive phase of sperm production was shown to be centered around the late prophase of meiosis. It is suggested that the normal construction of the genetic material was affected and that the mechanism of action of D_2O is at the macromolecular level. (auth)

11584

CALCIUM-STRONTIUM DISCRIMINATION BY RAT SALIVARY GLANDS. Robert H. Dreisbach (Stanford Univ., Calif.). *Proc. Soc. Exptl. Biol. Med.* **100**, 719-21(1959) Apr.

Percent of administered dose in blood, kidney, and salivary gland was determined from 6 minutes to 16 hours after intravenous injection of a mixture of Ca^{45} - Sr^{86} . Salivary glands retained Ca^{45} in preference to Sr^{86} , reaching a ratio of 4.6:1 at 16 hours. However, the

glands showed a distinct retention of Sr^{85} and contained 3.1 times the concentration in kidney 8 hours after injection. In secretion of saliva, the salivary glands showed less discrimination against Sr in favor of Ca than did uptake by the gland. After administration of tracer amount of Sr^{85} or of 2.5 meq/kg of normal Sr, ratio of Ca/Sr was only slightly greater in saliva than that in serum. (auth)

11585

RELATION OF VIRAL PROLIFERATION AND ANTIBODY FORMATION IN MICE EXPOSED TO ROENTGEN RADIATION. Lee W. Smith and F. S. Cheever (Univ. of Pittsburgh). Proc. Soc. Exptl. Biol. Med. **100**, 817-20 (1959) Apr.

X radiation administered prior to Cocksackie virus inoculation increased and prolonged the yield of virus from selected tissues, particularly the pancreas. X radiation administered prior to virus inoculation inhibited the specific immune response. The deleterious effects of irradiation on antibody formation were not long lasting, in that virus reinoculated 30 days after x-ray exposure evoked a prompt secondary response equal to that of control mice. X-radiation exposure prior to a second inoculation of virus inhibited the secondary response in both the previously irradiated and control mice. These data are compatible with the hypothesis that increased viral proliferation in x-radiated animals is due to the inhibition of the antibody response. (auth)

11586

THE RADIOLOGIST LOOKS AT RADIATION HAZARDS. Paul C. Hodges. Radiology **72**, 481-8(1959) Apr.

The clinical implications of the work of biophysicists and geneticists in diagnostic radiology hazards and risks are summarized. Developments toward reducing this hazard are pointed out. (T.R.H.)

11587

GENETIC EFFECTS IN CHILDREN AND GRAND-CHILDREN, OF WOMEN TREATED FOR INFERTILITY AND STERILITY BY ROENTGEN THERAPY. Ira I. Kaplan. Radiology **72**, 518-21(1959) Apr.

An analysis is made of the genetic changes of 2 generations from 644 women who had received 65 r to ovaries and 90 r to pituitary. It was found that despite claims that there is no safe dose, no increase in genetic damage was found. The incidence of genetic damage to these offspring was less than that in the normal population. (T.R.H.)

11588

A GENETICIST LOOKS AT THE RADIATION HAZARD. William J. Schull (Univ. of Michigan, Ann Arbor). Radiology **72**, 522-8(1959) Apr.

A compromise between the extremes from which radiologists and geneticists view the hazards of radiation is attempted. Various studies are reviewed to state the arguments of both sides; these studies are appraised and a plea is made for perspective. (T.R.H.)

11589

SPLEEN CELL SUSPENSIONS IN RADIATION-INDUCED BONE MARROW DAMAGE. Hans-Jürgen Thom and Karl Franz Hübner (Univ. of Heidelberg, Ger.). Strahlentherapie **108**, 371-82(1959) Mar. (In German)

Immediately after whole-body irradiation at 800 rep of inbred rats by high-energy electrons, the animals received an intravenous injection of 100 to 120×10^6 spleen cells of healthy animals of the same breed. As

compared with untreated control animals the regeneration of the radiation damaged bone marrow was more rapid qualitatively and quantitatively. The initial phase of damage was not changed. The first regenerations of the bone marrow of the treated animals were observed already at the third day after irradiation. A complete restitution was observed within 14 days as compared with 21 days in untreated animals. Principally erythropoiesis but also myelopoiesis have part in the more rapid regenerations. (auth)

11590

GROWTH DAMAGES AT VARIOUS DOSES IN SALAMANDER LARVAE AFTER IRRADIATION IN INCIPIENT FOOD ABSORPTION STAGE. Theofried Peters (Heiligenberg Inst., Ger.). Strahlentherapie **108**, 383-402(1959) Mar. (In German)

It was proved on triton alpestris that amphibian larvae, which were considered unusually resistant against radiation at high doses, were inhibited in their growth in a statistically significant way by a dose of 200 r. Higher doses increased the inhibition of growth and caused further damages. An x ray dose of 1280 r can be considered absolutely lethal; a dose of 640 r is very likely lethal. The damages, as they are visible by a magnifier, are described and discussed. (auth)

11591

RADIATION BIOLOGICAL INVESTIGATIONS ON SUPERCOOLED BOVINE SPERMATOZOIDS. Hans-Joachim Schmermund, Matthias Krahe, and Hans Adam Künkel (Universitäts-Frauenklinik, Hamburg). Strahlentherapie **108**, 403-7(1959) Mar. (In German)

Supercooled bovine spermatozooids were exposed to x ray doses of up to 20,000 r and warmed until some hours later. The damage provoked by the effect of the irradiation became evident through the slackened mobility of the spermatozooids. A certain quantity of cysteine, however, added to the cell suspension during the warming produced a distinct protective effect, though the protective substance was applied only after the irradiation. (auth)

11592

EXPERIMENTAL INVESTIGATIONS ON THE ORIGIN OF THE ACUTE AND LATER RADIATION DAMAGE IN THE KIDNEY. Ulrich Feine (Max-Planck-Institut für Biophysik, Frankfurt am Main and Univ. of Tübingen, Ger.). Strahlentherapie **108**, 408-20(1959) Mar. (In German)

After a single irradiation of the kidney of 84 albino rats during laparotomy with a dose between 1,000 and 80,000 r, the development of the acute radiation damage and the development of the contracted kidney caused by irradiation was followed histologically and histochemically. At the lowest dose only the tubulus cells showed damages in the acute state. The tubulus cells must be considered most sensitive to irradiation in the acute state. More and more significant damages of the vessels were observed after higher doses and an albuminuric nephrosclerosis develops. The lowest dose causing a contracted kidney was 1,000 r. It may be due to degeneration of the tubuli, but also changes of the smallest arteries of the cortex have to be considered. After increased doses of 7,000 r and more the vascular contracted kidney becomes dominant. The possibility of kidney damage after therapeutic irradiation was pointed out. (auth)

11593

TUMOR FORMATION AND TISSUE CHANGES PRODUCED BY RADON INHALATION. Friedrich Unnewehr (Max-Planck-Institut für Biophysik, Frankfurt am Main). *Strahlentherapie* 108, 421-7 (1959) Mar. (In German)

The pulmonary tumors observed in mice after the inhalation of radon were not only malignant tumors such as carcinoma of the bronchus, but also an increased number of benign tumors, adenomas. It seems that after inhalation of radon in low concentration over a period of several months an increased number of benign tumors occurs. Some of them become malignant after continued inhalation of radon of the same concentration over a period of at least 12 months. This is also substantiated by the histological appearance of these tumors, since primary adenocarcinomas of the lungs are extremely rare. In one case a beginning pulmonary fibrosis was observed, whose disappearance could not be expected. The observations are similar to industrial radium poisoning of humans. Two cases of this type were reported. An incidental finding was a great number of parasites in the neck muscles of the mice. (auth)

11594

RADIATION REACTION OF THE SKIN IN THE APPLICATION OF GLYCOCORTICOID. Karl Arno Rütter and Hans Günther Müller (Städtischen Frauenklinik, Wiesbaden, Ger.). *Strahlentherapie* 108, 475-7 (1959) Mar. (In German)

Local and combined local and oral hydrocortisone treatment during x ray therapy of 40 cases had no favorable effect on the course of the local radiation reaction as compared with 30 cases not treated with hydrocortisone. In the majority of the cases an increased and earlier skin reaction was observed instead. In the treatment of epidermolysis the local combined use of pantothenic acid and Vitamin A was superior to the treatment with hydrocortisone. (auth)

CHEMISTRY

General

11595 AECU-4042

Purdue Univ., Lafayette, Ind.

THE CHEMISTRY AND NUCLEAR CHEMISTRY OF THE HEAVY ELEMENTS. Progress Report No. 4. J. W. Cobble, ed. Feb. 1959. 71p. Contract AT(11-1)-347. \$12.30(ph), \$4.50(mf) OTS.

Many problems in nuclear reactions involve very small cross sections and therefore can only be studied by working with very low activities. In order to investigate some of these reactions, it was necessary to set up a β counter with a very low background. A discussion of this counter is presented. The 5×5 inch NaI(Tl) well-type scintillation crystal has been used to determine the absolute disintegration rates for specific fission product nuclides. The calibration curve is presented for this γ scintillation counter. The fission products which have been counted by this method are As^{76} , Ru^{103} , Ru^{105} , 1^{130} , 1^{131} , Ce^{141} , and Ce^{143} . The Frisch-Grid alpha spectrometer has been completed for analysis of heavy elements, particularly of Np. The design and preparation of plastic scintillation crystals for the β - γ , γ - γ coincidence spectrometer are discussed. The work on alpha fission of U^{235} has been completed. The work on alpha fission of

U^{238} is essentially complete. A series of bombardments was carried out on U^{235} at different energies to study the primary fission yields. The decay schemes of Rb^{86} , Ru^{105} , and Pd^{109} are being studied. A final design of the Ta calorimeter was reached. The thermistor bridge was altered in order to improve stability of the circuit. (For preceding period see AECU-3663.) (W.L.H.)

11596 AECU-4092

Stanford Research Inst., Menlo Park, Calif.

REACTIONS OF METALS WITH OXYGEN AND

STEAM. Final Report [for] June 15, 1958 to

February 15, 1959. Fred E. Littman and Frank M. Church. Feb. 15, 1959. 25p. [For Oak Ridge National Lab.]. Contract W-7405-eng-26. Subcontract 1088. SRI Project SD-2116. \$4.80(ph), \$2.70(mf) OTS.

Titanium, zirconium, and Zircaloy can spontaneously ignite under relatively mild conditions. The effect of temperature, oxygen concentration and pressure, and the nature of the diluent on the spontaneous ignition of titanium, zirconium, and Zircaloy were investigated. (J.E.D.)

11597 AERE-C/R-2843

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN ULTRA-MICRO METHOD FOR THE ESTIMATION OF THE RARE EARTHS BY COMPLEXOMETRIC TITRATION. E. A. C. Crouch and I. G. Swainbank. Feb. 1959. 10p. \$0.25(BIS).

The estimation of $10\text{-}\mu\text{g}$ quantities of rare earth metals is described using EDTA titration and Xylenol Orange indicator. The end point is detected photometrically. (auth)

11598 AERE-CE/M-230

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THORIUM OXALATE DIHYDRATE AS A THORIUM STANDARD. P. J. Alder and R. Todd. July 1958. 5p.

Methods of preparation and the properties of thorium oxalate dihydrate are presented. The dihydrate is used as a thorium standard. (auth)

11599 CEI-58

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THE ANALYSIS FOR PLUTONIUM BY COUNTING METHODS. A. M. Aikin and T. Bruce. June 15, 1953. 10p.

The LaF_3 method for determining plutonium was investigated and found to give results below 95% of true value. The self-absorption of alphas in Pu sources containing U was measured as a function of U concentration. The absorption reaches 5% when the source contains 500 μg of U. Hence for solutions of Pu and U better accuracy is obtained if the solution is alpha counted directly and corrected for self-absorption than if the Pu is separated by LaF_3 precipitation and counted on the La precipitate. The precision decreases as the amount of U on the source increases. (auth)

11600 CRDC-837

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE APPLICATION OF THE 1-(2-PYRIDYLazo)-2-NAPHTHOL METHOD OF URANIUM ANALYSIS TO THORIUM PROCESS SOLUTIONS. I. H. Spinner and F. C. Miller. Feb. 1959. 8p. (AECL-789). \$0.20 (AECL).

The application of the 1-(2-pyridylazo)-2 naphthol method of uranium analysis to thorium process solutions is described. The method covers the range 2-50 micrograms of uranium and is particularly effective in the presence of large excesses of thorium. (auth)

11601 GAT-247(Suppl. 1)

Goodyear Atomic Corp., Portsmouth, Ohio.
FOUR-TOWER WATER TREATMENT TEST FACILITY (SECOND RUN). R. G. Murray and M. E. Tester.
Apr. 3, 1959. 16p. Contract AT(33-2)-1. \$3.30(ph), \$2.40(mf) OTS.

Data collected during the second run made with untreated water in the laboratory test facility constructed for studying corrosion supplement the information obtained in the first run when phosphate-treated water was used. In the test facility, there was less corrosion of the copper condenser tubes when untreated water was used than when phosphate-treated water was used. Also, the untreated water deposited much less silt on the tubes. However, steel piping in the test system was severely corroded by the untreated water. (auth)

11602 HW-58967

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SOME PRACTICAL ASPECTS OF X-RAY SPECTROGRAPHY. M. C. Lambert. Jan. 22, 1959. 65p. Contract W-31-109-Eng-52. \$1.75(OTS).

A summary-type discussion of the principal factors involved in x-ray spectrography is presented. In addition, techniques of sample preparation, the analysis of a variety of heterogeneous samples, and other applications such as the measurement of film thickness are described. (J.R.D.)

11603 IGR-TN/CA-1048

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

A STUDY OF SOME CORROSIVE FLUORIDES BY NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY.
A. N. Hamer, J. Leece and P. G. Bentley. 1959. 17p.

A study of the merits of nuclear magnetic resonance spectroscopy for investigating mixtures of halogen compounds is presented, as well as full details of the experimental procedure (including the construction of a cold probe) which was developed to obtain the appropriate spectra. It is shown that the initial promise of the method as a means of analysis was not fulfilled because of the collapsed spectra exhibited by mixtures and impure compounds. This is caused by the presence of hydrogen fluoride which promotes rapid intermolecular fluorine exchange. (auth)

11604 LS-10

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON THE CHEMISTRY OF RUTHENIUM IN NITRATE SOLUTIONS. Sept. 1958. 6p.

Thirty-six references to report and published literature on the chemistry of Ru in nitrate solutions are given. Sources considered included Nuclear Science Abstracts, Jan. 1948 to June 1958, and Chemical Abstracts, Jan. 1930 to Aug. 1958. (L.T.W.)

11605 LS-11

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON DETERMINATION OF CARBON DIOXIDE. Sept. 1958. 6p.

Twenty-nine references from the published literature on determination of CO₂ are given. Analytical Abstracts, Jan. 1954 to July 1958, was the source. (L.T.W.)

11606 LS-19

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON THE ELEMENTS: CERIUM, EUROPIUM, MOLYBDENUM, PROMETHIUM, TECHNETIUM, ZIRCONIUM. 1. THEIR CHEMISTRY IN NITRIC ACID SOLUTIONS. 2. THEIR VOLATILE COMPOUNDS AND VOLATILIZATION METHODS. Oct. 1958. 21p.

This survey includes 148 references from the report and published literature on the elements Ce, Eu, Mo, Pm, Tc, and Zr. Chemical Abstracts, Jan. 1923 through Sept. 1958, and Nuclear Science Abstracts, Jan. 1948 through Aug. 1958, were the sources. (J.E.D.)

11607 LS-35

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON METAL-ORGANIC COMPOUNDS, PROPERTIES, CHEMISTRY, PREPARATION. Feb. 1959. 43p.

This survey includes 338 references from the published literature on the properties, chemistry, and preparation of metal-organic compounds. Chemical Abstracts, 1921 to 1956, was the source. (J.R.D.)

11608 NP-7372

Iowa State Coll., Ames.
ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH TEMPERATURE LUBRICANTS AND RELATED MATERIALS. Progress Report for December 16, 1958 to March 31, 1959. Henry Gilman, Bernard J. Gaj, and Oren L. Marrs. 29p. Contract AF33(616)-6127.

Some reactions in tetrahydrofuran have been extended. A reaction has been developed to extend the availability of new organosilyllithium compounds having more than one silicon atom. Another important cleavage reaction of disilanes has been examined. It has been observed that S reacts with triphenylsilyllithium in tetrahydrofuran to give the lithium salt of triphenylsilanethiol. A series of reactions has been described in which some olefins were treated with R₂SiM compounds. (For preceding period see WADC-TR-53-426(Pt. VI).) (W.L.H.)

11609 NP-7396

Mine Safety Appliances Co., Callery, Penna.
INERT GAS FROM AIR USING SALCOMINE. Memo Report 71. Walter Milich, E. C. King, and R. C. Werner. Dec. 16, 1954. 10p. Contract NObs-65426.

A short literature study was made on production of an inert gas from air by removing the oxygen with Salcomine, a regenerative cobalt chelate. Maximum inert gas purity depends on the operating pressure, estimates giving 2 vol. % O₂ remaining at 100 psig and 0.25 vol. % after 1000 psig operation. Experimentation is necessary to confirm the estimated purities and to demonstrate the feasibility of operation. (auth)

11610 NP-7401

Mine Safety Appliances Co., Callery, Penna.
SODIUM REACTIVITY TESTS—FIBERFRAX INSULATION. Memo Report 79. W. Milich and E. C. King. Mar. 2, 1955. 3p. Contract NObs-65426.

Samples of "Fiberfrax" insulation were immersed in sodium under an inert atmosphere at 500°F for 10 minutes and 1 hour periods. There was no apparent reaction with the sodium other than a slight charring at the outer surface of the insulation. (auth)

11611 NP-7415

Mine Safety Appliances Co., Callery, Penna.
REMOVAL OF MERCURY FROM SODIUM. Memo Report 97. S. J. Rodgers. Nov. 22, 1955. 5p. Contract NObs-65426.

Three methods of removal of mercury from sodium were studied: fractional crystallization, amalgamation with copper, and cold trapping. Fractional crystallization and amalgamation with copper showed promise in small systems but proved impractical in larger systems; cold trapping was ineffective. Copper corrosion in 800°F sodium was increased by a factor of ~24 over corrosion in 600°F sodium. (auth)

11612 NP-7422

Mine Safety Appliances Co., Callery, Penna.
REACTION TEST; HOT NaK-BIPHENYL. Memo Report III. W. Milich and E. C. King. May 14, 1956. 5p. Contract NObs-65426.

A small quantity of NaK (56 wt. % K, ~6 grams) and biphenyl (~6 grams) were mixed and heated gradually to a temperature of 800°F under a cover of nitrogen to see if any chemical reaction would take place. The biphenyl first vaporized, as was evident by the vapors being expelled at 500 to 540°F. With further heating biphenyl vapors were no longer evident when the mixture reached 740°F and visual inspection of the remaining NaK after cooling indicated that all the biphenyl had been vaporized. It was therefore concluded that no chemical reaction was evident when heating small quantities of NaK and biphenyl under nitrogen at atmospheric pressure to 800°F. (auth)

11613 NP-7424

Mine Safety Appliances Co., Callery, Penna.
INDICATION OF CATALYTIC DECOMPOSITION OF BIPHENYL AND DOWTHERM A. Memo Report 114. J. W. Mausteller and K. R. Barker. July 11, 1956. 4p. Contract NObs-65426.

Three items were discovered relating to the possible catalytic decomposition of biphenyl (or Dowtherm A). Nickel is the catalyst in all cases, one reference being to the decomposition of biphenyl during production, the other two being high makeup requirement for Dowtherm A in Type A nickel process systems operating at ~700°F. Capsule tests should be made to determine catalytic effects on isopropyl biphenyl and biphenyl. (auth)

11614 NP-7432

Mine Safety Appliances Co., Callery, Penna.
AMMONIUM PENTABORATE OCTAHYDRATE SOLUBILITY STUDIES IN H₂O. Memo Report 127. E. F. Batutis and C. A. Palladino. Apr. 26, 1957. 8p. Contract NObs-65426.

A study was made to determine the maximum amount of ammonium pentaborate octahydrate which could be added to H₂O at an initial temperature of 40 to 200°F and, after five minutes of mild agitation, could be completely dissolved. With granular APBO not more than 30% of that amount required for saturation could be added in the 60 to 80°F H₂O range and about 40% in the 80 to 180°F range. Mixing rate and mixing technique will definitely affect dissolving time. Powdered APBO dissolves more readily but sometimes produced somewhat cloudy solutions which were difficult to evaluate. At an initial H₂O temperature of 40°F larger quantities (0.35 of saturation) of APBO powder could be dissolved under the same conditions than could granular APBO (<0.10 of saturation). At higher temperatures, APBO powder was only slightly higher in solution rate than was granular APBO. The cooling caused by the APBO negative heat of solution will control the amount of APBO which can be added at the higher temperatures (120 to 200°F) under the same test specifications. (auth)

11615 NP-7438

MSA Research Corp., Callery, Penna.
A FEASIBILITY STUDY OF ANALYTICAL METHODS FOR DETECTING CHLORIDE ION AT LESS THAN 100 PARTS PER BILLION CONCENTRATION IN STEAM BOILER SYSTEMS. Memorandum Report 137. E. F. Batutis. Nov. 6, 1958. 14p. Contract NObs-65426.
Analytical techniques for chloride detection in the < 100 ppb range were reviewed and evaluated. Instruments such as the Quantichem Analyzer offer the best possibility of meeting the specifications. Colorimetry is recommended as the best route to probable success on this problem. Other methods were deemed feasible if concentration techniques could be conceived, but this approach would require additional research and development. (auth)

11616 NP-7461

Midwest Research Inst., Kansas City, Mo.
DEVELOPMENT OF THERMALLY STABLE SILICON CONTAINING RESINS. Quarterly Progress Report No. 9 [for] November 16, 1958-March 13, 1959. L. W. Breed. 33p. M.R.I. Project No. 786-C. Contract AF33 (616)-3675.

Continuing research aimed at preparing silicon-containing polymers which are more rigid at elevated temperatures is reported. Areas which were investigated during this report period include silane-penterythritol systems, silane-piperazine systems, siloxy-aluminum model compounds and polymers, siloxy-titanium materials, and other types of monomers. (auth)

11617 NP-7469

Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
ON THE AGING BEHAVIOR OF THE ALLOY Ti-6Al-4V. Technical Report No. 2 [on] PHYSICAL METALLURGY OF TITANIUM ALLOYS. J. M. Dupouy, M. B. Bever, and B. L. Averbach. Mar. 31, 1959. 23p. Contract Nonr-1841(02).

The effects of aging in the temperature range 800 to 1100°F (427 to 593°C) on the mechanical properties of the alloy Ti-6Al-4V were investigated. As the aging progressed, the tensile strength, yield strength, and hardness went through two and, in some instances, three maxima and the ductility developed a minima. The lower the aging temperature, the longer were the times required to reach these maxima and minima and the lower were the values of the strength properties. The amount of beta phase was measured as a function of aging time at different aging temperatures using an x-ray technique which employed a scintillation counter and a pulse-height analyzer. The amount of beta increased with aging time, and it appeared that its vanadium content also increased. The precipitation of beta from alpha prime is proposed as an explanation for the first or second observed maximum in the strength properties. The third maximum may be related to solid solution strengthening of the beta. (auth)

11618 PM(S)-7

Gt. Brit. Springfields Works, Springfields, Lancs, England.
A RÉSUMÉ OF PAST WORK ON URANIUM PEROXIDE PRECIPITATION. E. Hawthorn. June 25, 1953. 9p. (SWTC/R-29).

Experiments carried out at Springfields laboratory on the precipitation of uranium peroxide are presented. (W.L.H.)

11619 UCRL-8654

California, Univ., Berkeley. Lawrence Radiation Lab. MASS SPECTRA OF SOME ORGANIC AND INORGANIC COMPOUNDS. Amos S. Newton and Sylvia J. Waters. Feb. 1959. 50p. Contract W-7405-eng-48. \$1.50 (OTS).

A compilation was made of some mass spectra of various organic and inorganic compounds which are not listed in previous compilations of mass spectral data. These compounds were collected from various sources, and many are the result of syntheses in the University of California Chemistry Department or the Lawrence Radiation Laboratory. All have appreciable vapor pressures at room temperature and were run with a room temperature inlet system on a Consolidated Engineering Corporation Model 21-103 (a few were run on Model 21-102) analytical mass spectrometer. (auth)

11620 UCRL-8675

California, Univ., Berkeley. Lawrence Radiation Lab. LARGE MOLECULES IN CARBON VAPOR. Kenneth S. Pitzer and Enrico Clementi. Mar. 1959. 35p. Contract W-7405-eng-48. \$1.00(OTS).

The molecular orbital theory is used in appropriate semi-empirical forms to predict the properties of carbon vapor. The results indicate that linear polyatomic molecules: $C = C = C \cdots C = C$: are the important species. Experimental results from the literature for C_3 are combined with the calculated conjugation or resonance energies and with the heats of formation of allene and ethylene to predict heats of formation for all larger carbon molecules. It is found that the odd species have closed shell structures and lower energies than the even species but that the even species should show greater electron affinity. Both of these results are consistent with the mass spectrometric results of Honig and of Chupka and Inghram. Molecular spectroscopic data on C_3O_2 are used to estimate the free energy function increments for the species above C_3 . The calculated partial vapor pressures predict C_3 to be the most abundant species in the saturated vapor even at 2000°K with C_7 becoming comparably abundant in the 2500 to 3000°K range. At higher temperatures even larger molecules should become important. The results are shown to be generally consistent with all reliable vaporization data provided the evaporation coefficients decrease rapidly for increasing molecular size and vary for different crystal surfaces of graphite. The calculated electronic energy levels for C_2 and C_3 agree satisfactorily with the observed spectra and trends are predicted for both even and odd larger species. It is proposed that liquid carbon consists of essentially infinite linear chains of this type. Both entropy and energy considerations lead to predicted heats of fusion of about 10 kcal/gm atom at 4000°K; the agreement between the two values indicates at least the absence of any serious inconsistency. (auth)

11621 WADC-TR-53-426(Pt. 6)

Iowa State Coll., Ames.

ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH TEMPERATURE LUBRICANTS AND RELATED MATERIALS. [Period covered]: August 15, 1957 to December 15, 1958. Henry Gilman, Bernard J. Gaj, Justin W. Diehl, Oren L. Marrs, and William J. Trepka. Dec. 15, 1958. 148p. Project title: AVIATION LUBRICANTS. Task title: LIQUID AND SOLID LUBRICANTS DEVELOPMENT. Contract AF33(616)-3510.

New organosilicon hydrides and organosilylmetallic compounds have been prepared as synthetic tools. Their wide reactivity has been examined with a series of func-

tional organic and inorganic compounds in a study concerned with custom-made molecules, among which are included new cyclic organosilicon compounds. Some of these have been screened for antioxidant properties. The experimental part contains a table which describes the preliminary screening for thermal stability of some of the new compounds. (auth)

11622 AEC-tr-3626

CONEERNING THE ELECTROLYTIC DEPOSITION OF METALLIC NIOBIUM. IL N. Izgarishev (Isgarishev) and G. E. Kaplan. Translated by H. P. Raaen (Oak Ridge National Lab.) from *Z. Electrochem.* **40**, 33-6 (1934). 10p. \$1.80(ph), \$1.80(mf) JCL or LC.

Electrolytic deposition of metallic Nb on the cathode was investigated. Electrolytes were prepared by an alkaline method and by citric acid and oxalic-acid solutions. In the alkaline and oxalic acid solutions, the Nb is partly deposited on the cathode in electrolysis, and in addition forms compounds from which deposition by means of electrolysis is no longer possible. The distribution of the Nb between solution and deposit was determined as well as the complete system balance. (J.R.D.)

11623 AEC-tr-3658

THE MECHANISM OF THE CATHODE PROCESS IN THE ELECTROLYSIS OF A FUSED NaCl-CaCl₂ MIXTURE ON AN IRON CATHODE. L. Suskii. Translated by A. L. Monks (Oak Ridge National Lab.) from *Zhur. Fiz. Khim.* **32**, 1785-95(1958). 30p. (Includes original, 11p.) \$4.80(ph), \$2.70(mf) JCL or LC.

The cathode process in the electrolysis of a fused NaCl-CaCl₂ mixture on an iron cathode is examined. Factors given special attention were the sequence of electro-chemical processes for the discharge of individual ions at the cathode, and the cathode potential as a function of time. Additional measurements were carried out to confirm the validity of the hypothesis according to which the anodic potential was assumed to be constant. Results indicate that calcium is separated at the cathode and sodium is precipitated out. (J.R.D.)

11624 NP-tr-231

ANALYSIS OF PURE METALS. V. A. Nazarenko. Translated for Lincoln Lab., MIT from *Zavodskaya Lab.* **23**, 1162-7(1957). 9p.

A review of methods to determine substances with concentrations of 10^{-5} to $10^{-8}\%$ with 44 references (all but one from Russian sources) are presented. (W.L.H.)

11625

RADIOCHEMICAL TRACER ANALYSIS: A NEW APPROACH RESULTING IN INCREASED ACCURACY. D. A. Lambie (Radiochemical Centre, Amersham, Bucks, Eng.). *Analyst* **84**, 173-6(1959) Mar.

It is shown that the errors inherent in radioactive tracer analysis may be reduced by measuring the un-separated rather than the separated fraction of the radioactivity. (auth)

11626

CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF COPPER AND URANIUM. W. D. Shults and P. F. Thomason (Oak Ridge National Lab., Tenn.). *Anal. Chem.* **31**, 492-4(1959) Apr.

Solutions of copper and uranium sulfate can be analyzed with relative standard deviations of about 0.1% by controlled-potential coulometric titration if both ions are reduced at -0.3 volt and copper only is re-oxidized at +0.175 volt. The method is not affected by the copper-uranium ratio. (auth)

11627**ACID-BASE REACTIONS IN OXIDATION MECHANISMS.**

Frederick R. Duke (Iowa State Coll., Ames). Anal. Chem. **31**, 527-9(1959) Apr.

The hypothesis is advanced that in general, oxidation-reduction reactions are preceded by, or are simultaneous with, an acid-base step. Application of the hypothesis allows the research analytical chemist to decide such things as when a reaction might be slow and what catalyst might be effective for a given reaction. (auth)

11628**DISSOLUTION OF URANIUM METAL AND ITS ALLOYS.**

Robert P. Larsen (Argonne National Lab., Lemont, Ill.). Anal. Chem. **31**, 545-9(1959) Apr.

The most useful methods for the dissolution of uranium metal and its alloys are reviewed, with particular emphasis on the preparation of solutions for analysis. The behavior of the metal and its alloys in the common acids, ethyl acetate solutions of bromine and hydrogen chloride, and sodium hydroxide-peroxide mixtures is described. Recommendations for dissolving each of a wide variety of uranium alloys are summarized in tabular form. (auth)

11629

SEPARATION OF RARE EARTHS FROM BERYLLIUM, MAGNESIUM, ZIRCONIUM, TITANIUM, URANIUM, AND STAINLESS STEEL. M. W. Lerner and L. J. Pinto (U. S. Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem. **31**, 549-51(1959) Apr.

Certain rare earths possessing high thermal neutron absorption cross sections, when present in only trace quantities in metals used in nuclear technology, must be separated before a satisfactory spectrographic determination can be made. These rare earths are separated from beryllium and magnesium by precipitation as oxalates with added thorium as a carrier. The thorium is removed by an 8-quinolinol extraction leaving a residue suitable for spectrographic analysis. With zirconium, titanium, uranium, and stainless steel, a preliminary fluoride precipitation is made. At least 96% of the rare earths are consistently recovered. (auth)

11630

DETERMINATION OF ACTIVE HYDROGEN IN ORGANIC COMPOUNDS BY EXCHANGE WITH TRITIATED ISOPROPYL ALCOHOL. Jerome F. Eastham (Univ. of Tennessee, Knoxville) and Vernon F. Raaen (Oak Ridge National Lab., Tenn.). Anal. Chem. **31**, 555-8(1959) Apr.

Active hydrogen in a variety of organic compounds has been exchanged for tritium from excess tritiated isopropyl alcohol by dissolving each compound in the alcohol and then evaporating this solvent. The measured radioactivity taken on by most compounds agreed well with that expected from the number of active hydrogens in the compound and the known radioactivity of the solvent. The exchange technique should be satisfactory for determining the active hydrogen in compounds of unknown structure. (auth)

11631

FLUOROMETRIC DETERMINATION OF SUBMICROGRAM QUANTITIES OF BERYLLIUM. Claude W. Sill and Conrad P. Willis (U. S. Atomic Energy Commission, Idaho Falls, Idaho). Anal. Chem. **31**, 598-608(1959) Apr.

The increasing use of beryllium in the atomic energy program and the highly toxic nature of its compounds require a method of high sensitivity and reliability for its detection and determination. Although morin is the most sensitive reagent known for the determination of beryllium, available procedures are not particularly reliable at extremely low levels. A fluorometric method using morin has been developed that has a detection limit of 0.0004 γ and a precision to 0.8% on 0.2 γ at the 95% confidence level. Reliability and precision are improved greatly through use of a buffer system, an internal acid-base indicator, a permanent glass standard of fluorescence, and complexing agents. Detailed methods of separation of beryllium and application to air-dust and smear samples, urine, bone, ores, and steel are given. They were checked at each step using beryllium-7 tracer. Errors produced by certain metals and by variations in the procedure are described. (auth)

11632

RAPID MICRODETERMINATION OF FLUORINE IN ORGANIC COMPOUNDS. R. N. Rogers and S. K. Yasuda (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. **31**, 616-17(1959) Apr.

In a rapid and accurate method for the microdetermination of fluorine in organic compounds the Schöniger combustion technique is used for initial decomposition of the sample, followed by an improved ferric salicylate colorimetric analysis. Samples ranging from 0.4 to 20 mg. were successfully analyzed in 10 to 20 minutes. Accuracy and precision are adequate for determination of empirical formulas. (auth)

11633

APPLICATIONS OF VERTICAL UPWARD PAPER PARTITION CHROMATOGRAPHY TO THE DETERMINATION OF CERTAIN ELEMENTS IN MINERALS. H. Agrinier (Commissariat à l'Énergie Atomique, Paris). Bull. soc. franc. mineral. et crist. **80**, 181-93; 275-92(1957). (In French)

Qualitative microanalysis methods are seen to be insufficiently selective or too complex. Chromatography was used to combat these difficulties. In particular elements whose presence is only shown with difficulty by classical techniques were considered, that is lithium, boron, beryllium, niobium, and tantalum. Techniques for semi-quantitative analysis of the presence in minerals of the cations, silver, nickel, cobalt, copper, niobium, tantalum, and titanium were established. (auth)

11634

THE SELENIDES OF THE LANTHANIDES Me_2Se_3 (FROM LANTHANUM TO GADOLINIUM), Th_3P_4 TYPE WITH A WIDE RANGE OF HOMOGENEITY. André Benacerraf and Micheline Guittard. Compt. rend. **248**, 2012-14(1959) Apr. 1. (In French)

The preparation and properties of the selenides Me_2Se_3 of La, Ce, Pr, Nd, Sm, and Gd are given. All these selenides crystallize in the cubic system of the Th_3P_4 type and exist at the interior of a wide region of homogeneity. The dissociation of these compounds in vacuum and at different temperatures was studied. The lower limit of the phase was determined only in the case of samarium selenide $SmSe_{1.27}$. (tr-auth)

11635

QUANTUM MECHANICAL EFFECTS AND THE RATE OF ELECTROLYTIC LIBERATION OF HYDROGEN

AND DEUTERIUM AS A FUNCTION OF TEMPERATURE. S. G. Khristov (Inst. of Chemistry and Tech., Sofia). Doklady Akad. Nauk S.S.S.R. **125**, 143-6(1959) Mar. 1. (In Russian)

The temperature dependence of current density was studied by means of the Eckart barrier in order to determine the importance of the tunnel effect in H_3O^+ and D_3O^+ discharge. The dependence of activation energy on the width of the barrier at $E_0 = 1.6$ erg was plotted, and the discharges H_3O^+ ($E_0 = 1.6 \times 10^{-12}$ erg) and D_3O^+ ($E_0 = 1.6 \times 10^{-12}$ erg) were tabulated and analyzed. The density of the "tunnel current" is about 55% at $T = 373^\circ$ to 80% at $T = 273^\circ$ of the total current density for H^+ and 30 to 50% for D^+ . Thus the tunnel effect in a real barrier is not smaller, but may be even larger, than in the equivalent Eckart barrier. (R.V.J.)

11635

APPLICATION OF RADIOACTIVE INDICATORS FOR THE DETERMINATION OF THE NUMBER OF IONS PASSING THROUGH A MEMBRANE. I. THEORETICAL CONSIDERATIONS. A. P. Despich. Glasnik Khim. Drushtva, Beograd **21**, 9-18(1956). (Translated from Referat. Zhur. Khim. No. 20, 1958, Abstract No. 66948.)

A new method employing radioactive indicators for the determination of the number of ions passing through a membrane was developed. In an electrical cell a space separating cathode and anode has a membrane. The space around the cathode is filled with a nonradioactive solution of the same concentration as on the other side of a membrane around the anode, which is filled with a radioactive solution. In the process of electrolysis, the radioactive ions pass through the membrane towards cathode. This offers an opportunity of counting ions that passed. The effect of self-diffusion of the radioactive indicator through the membrane was investigated. A quantitative evaluation of the latter is made for the purpose of eliminating the side effects and thus obtaining absolute values of the ion transfer.

11637

RADIOASSAY OF URANIUM AND PLUTONIUM IN VEGETATION, SOIL AND WATER. E. L. Geiger (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys. **1**, 405-8(1959) Mar.

A method is discussed for the separation of uranium and plutonium from vegetation, soil and water. The method is based on the extraction of uranium and plutonium from 4 to 6 N nitric acid into 50% tri-n-butyl phosphate in n-tetradecane diluent. Uranium and plutonium are recovered together with sufficient reduction in total solids to allow α -counting and pulse height analysis. Data from several hundred "spiked" samples to which uranium and plutonium were added indicate a nearly equal recovery of uranium and plutonium. Average recoveries are 76 ± 14 per cent for vegetation, 76 ± 16 per cent for soil, and 82 ± 15 per cent for water. The procedure is designed for samples that may be collected and analyzed for radioactivity as a part of a health physics regional monitoring program. (auth)

11638

INVESTIGATION OF ISOTOPE EXCHANGE REACTIONS BETWEEN ORGANIC IODIDES AND IODIDE IONS. F. Dutka and D. Gál (Hungarian Academy of Sciences, Budapest). Intern. J. Appl. Radiation and Isotopes **5**, 106-13(1959) Mar.

The kinetics of the isotopic exchange taking place at

56°C between ethyl, n-propyl, n-butyl, 2-phenylethyl, 3-phenylpropyl and 4-phenylbutyl iodides and potassium iodide labelled by I^{131} in absolute ethanol were examined. With the use of the kinetic curves, the rate constants were calculated. An appreciable decrease in rate constant and hence in reactivity was observed with increasing number of carbon atoms in the chain. The changes in activation energies occurring with increasing number of carbon atoms of the chain were established. (auth)

11639

SEPARATION OF GALLIUM FROM ZINC, COPPER, COBALT, NICKEL, AND IRON BY ION EXCHANGE. A. I. Zelyanskaya and N. V. Bausova. Izvest. Vostochn. Filialov Akad. Nauk S.S.S.R. No. 7, 51-3(1957). (Translated from Referat. Zhur. Met. No. 4, 1958, p.333.)

Polarographic determination of Ga in a passive electrolyte of the composition 0.1 M Na salicylate, 0.1 M NaCl, pH 2.5 to 3.8 is inhibited by Co, Ni, Zn, and large amounts of Cu. SBS cationite was used in the Na form in columns of 1 cm diameter, 50 cm high, to remove the inhibiting impurities. The resin, of 0.25 to 0.5 mm grain size, was charged to a height of 25 cm. A 100-cc solution containing 15 cc concentrated NH_4OH and 10 cc 2N. NaOH was transmitted through the resin at a rate of 5 cc/min, as a result of which the Ga remained in the filtrate in its entirety, and the Ni, Co, Zn, and Cu underwent quantitative absorption by the cationite. The resin was washed by a 100-cc solution containing 10 cc concentrated NH_4OH and 5 cc 2N. NaOH. The filtrate and the wash waters were evaporated down to a volume of 25 cc and were neutralized by 6N HCl, and the Ga was determined polarographically. Extraction of the Ga in the filtrate attained 98 to 100% when the solution contained 0.5 to 5.0 mg.

11640

THE EFFECT OF IONIZING RADIATION UPON γ - Al_2O_3 AS A CATALYST FOR H_2 - D_2 EXCHANGE. Harold W. Kohn and Ellison H. Taylor (Oak Ridge National Lab., Tenn.). J. Phys. Chem. **63**, 500-5 (1959) Apr.

Relatively small doses of γ rays at -78°C have been found to enhance the H_2 - D_2 exchange activity of γ - Al_2O_3 . The enhancement by radiation depends upon the presence of a catalyst poison, H_2O , H_2 or C_2H_4 , and in the case of H_2O is a function of the extent of poisoning, being greatest for the most highly poisoned samples. However, Al_2O_3 not activated by high temperature treatment is not made active by prolonged irradiation. The enhancement in activity produced by radiation decays fairly rapidly at room temperature and above, and appreciable decay can be noted in some samples (highly poisoned ones, highly sensitive to radiation) even at -78°C . Reactor radiation (fast neutrons and γ rays) and radon produce similar enhancement, but in this case the effect does not decay markedly at room temperature. Although it is not yet possible to assign these effects surely to electron trapping (for gammas) and atom displacement (for heavy particles), these are the most attractive hypotheses at present. In any case, it appears likely that further study of these phenomena will help to clarify the importance for catalysis of various crystal imperfections. (auth)

11641

THE EXCHANGE OF DEUTERIUM GAS WITH THE HYDROGEN ASSOCIATED WITH SOLID CATALYSTS. I. THE MODEL TANTALUM-HYDROGEN SYSTEM.

Francis J. Cheselske, W. E. Wallace, and W. Keith Hall (Mellon Inst., Pittsburgh). *J. Phys. Chem.* **63**, 505-12(1959) Apr.

A study of the kinetics of the exchange reaction between pure deuterium gas and tantalum initially containing interstitial hydrogen has been made with a view to establishing the feasibility of the method for studies of the nature of the hydrogen content of solids, both with regard to the amount of hydrogen initially held by the solid, and also as to the energetics of the exchange reaction. The tantalum-hydrogen system was selected as a "model system" because the interstitial hydrogen occupies sites of equivalent energy approximating a model required for a simple, theoretical treatment; also, the exchange takes place at relatively high temperatures, minimizing the isotope effect. The kinetic experiments were made using both constant temperature and continuously rising temperature techniques. The results were found to be in good agreement, indicating that the rising temperature technique can be used advantageously to obtain the parameters of interest, the principal advantages being a large saving of time. From the isothermal data, it was possible to determine the true activation energy for the underlying rate process. The same data showed that the apparent activation energy and the true activation energy differed approximately by the heat of solution of hydrogen in tantalum. It is of interest to note that the true activation energy for the underlying rate process probably sets an upper limit on the activation energy for diffusion of hydrogen through the tantalum lattice. The results obtained in this investigation should serve to establish a criterion by which results obtained from systems of catalytic interest can be compared. (auth)

11642

DEVIATIONS FROM PLATE THEORY IN THE ION-EXCHANGE SEPARATION OF TECHNETIUM AND RHENIUM. R. N. Sen Sarma, Edward Anders, and J. M. Miller (Univ. of Chicago and Columbia Univ., New York). *J. Phys. Chem.* **63**, 559-65(1959) Apr.

Technetium and rhenium in their highest oxidation states can be separated by ion-exchange chromatography on the synthetic resin Dowex 1, using perchlorate ion as the elutriant. In 0.1 and 0.2 *f* HClO₄ solutions, the peak elution volumes (in units of free column volumes) are 43.0 ± 0.8 and 23.6 ± 0.4 for ReO₄⁻, and 85.2 ± 1.9 and 43.7 ± 0.7 for TcO₄⁻, respectively. The trailing edges of the elution curves deviate markedly from the predicted Gaussian shape, and the observed separation factors differ from those calculated from the plate theory of Mayer and Tompkins, and Glueckauf, by factors of 10^3 to 10^{18} . Part of the discrepancy is due to a chemical cause, presumably radiocolloid formation, and can be eliminated by appropriate chemical treatment. In addition, there appears to be a "residual" tailing-effect which can be reduced, but not eliminated, by changing the experimental variables. This effect, which appears to arise from the infrequent occurrence of a second, slow exchange process, limits the maximum separation factors attainable to 10^4 - 10^5 , irrespective of the number of theoretical plates. The mechanism of this process could not be established with certainty, although its dependence on flow rate was consistent with the behavior expected if the chemical exchange reaction with the exchange site,

rather than film or particle diffusion was the rate-determining step. It appears that the "residual" tailing-effect is not limited to the two elements studied, but occurs in other systems as well. At high acid concentrations, a broadening and distortion of the technetium peaks was observed, indicating oxidation of the resin by pertechnetate. (auth)

11643

RARE EARTH METAL "DISILICIDES." John A. Perri, Ira Binder, and Ben Post (Polytechnic Inst. of Brooklyn). *J. Phys. Chem.* **63**, 616-19(1959) Apr.

Disilicides of Ce, Pr, Nd, Sm, Eu, Gd, Dy, and Y have been prepared. The Ce, Pr, and Nd compounds are tetragonal as previously reported; the Sm, Gd, Dy, and Y compounds are orthorhombic, space group Imma. Their structures are slightly distorted versions of the tetragonal MeSi₂ structure. The magnitude of the distortion appears to increase with decreasing size of the metal atom. Chemical and x-ray diffraction studies of "GdSi₂" indicate that the composition is actually close to GdSi_{1.4}. EuSi₂ crystallizes in the tetragonal system apparently due to the anomalously large size of the metal atom. (auth)

11644

TWO LIQUID SCINTILLATORS. R. N. Keller, Jesse M. Cleveland, and Frank Burlingame (Univ. of Colorado, Boulder). *J. Phys. Chem.* **63**, 640(1959) Apr.

Two compounds were observed to exhibit the highly unusual property of scintillating in the pure liquid state. These liquids are methyl anthranilate and ethyl anthranilate. Dilution of these compounds with suitable solvents, such as toluene, increases the scintillation activity. (W.L.H.)

11645

CONVERSION OF URANYL SULFATE TO NITRATE BY ION EXCHANGE. D. Dolar and I. Berglez. "J. Stefan" Inst. Repts. (Ljubljana) **4**, 139-42(1957).

The application of ion exchange columns for the conversion of uranyl sulfate to nitrate is described. The loading and elution curves are given. It is shown that only cation exchange column is suitable for this purpose. (auth)

11646

THE SORPTION OF STRONTIUM AND CALCIUM IONS BY SOILS. Yu. A. Polyakov (Dokuchaev Inst. of Soil Studies, Moscow). *Kolloid Zhur.* **21**, 221-5(1959) Mar.-Apr. (In Russian)

The exchange adsorption of calcium and strontium ions on soils and clays was studied by a radiotracer method. The basic equilibrium criteria were determined and the most important thermodynamic functions (ΔH_{298} , ΔF_{298}° , ΔS_{298}°) were calculated. The numerical values for ΔH , ΔF , and ΔS bear witness to the isoenergetic character of the reaction. They also show that the adsorption compound Soil—Sr is thermodynamically more stable than Soil—Ca. The results were used for calculating the most probable value of the discrimination coefficient for Sr⁹⁰ in the system soil—plant. In all cases examined the coefficient was found to have a value <1, varying between 0.8 and 0.9. (auth)

11647

REFRACTIVITY AND LATTICE CONSTANT RATIOS OF LITHIUM-6- AND LITHIUM-7-RICH FLUORIDES R. W. H. Stevenson (Univ. of Aberdeen, Scotland) and

P. T. Nettley (United Kingdom Atomic Energy Authority, Capenhurst, Ches, Eng.). Nature **183**, 1000-1(1959) Apr. 4.

The refractive index of Li^{I} -rich and Li^{II} -rich LiF crystals was measured and compared with that of normal LiF . The differences found are discussed in relation to the lattice constant. (T.R.H.)

11640

NEW OXIDATION STATES OF TECHNETIUM. J. E. Fergusson and R. S. Nyholm (University Coll., London). Nature **183**, 1039-40(1959) Apr. 11.

Ditertiary arsine (D) chelates of Tc^{3+} and Tc^{2+} were prepared and studied, establishing these two oxidation states of Tc. (T.R.H.)

11649

ENHANCEMENT OF RADIATION-INDUCED CROSSLINKING OF POLYVINYL CHLORIDE. S. H. Pinner (Tube Investments Research Labs., Cambridge, Eng.). Nature **183**, 1108-9(1959) Apr. 18.

Solid solutions of polyvinyl chloride (PVC) in diallyl and triallyl esters exhibited properties associated with high-density crosslinking when irradiated. A preliminary kinetic analysis showed that a simple energy transfer mechanism is inadequate. The ability of allyl esters to increase crosslinking in PVC during irradiation is probably due to the short propagation chain-length and the accumulation of stabilized radicals. It is suggested that the allyl ester operates by "secondary" initiation (to distinguish from that of incident radiation.) (T.R.H.)

11650

REFRACTIVE INDEX OF URANIUM OXIDE PRODUCED BY ANODIC OXIDATION. A. E. Stebbens and L. L. Shreir (Battersea Coll. of Tech., London). Nature **183**, 1113-14(1959) Apr. 18.

Interference colors observed during anodic oxidation of U in aqueous NH_3 led to the investigation of an optical reflectivity method for studying film growth. Part of the oxide layer was dissolved in H_2SO_4 leaving an oxide step which, when measured, gave a refractive index of $\mu = 1.93$. The technique was extended so that even if the metal is soluble in the acid, an oxide wedge can be formed which exhibits interference fringes which can be studied. This method yielded a value of $\mu = 1.95$. (T.R.H.)

11651

NATURE OF FLUORESCENCE OF URANIUM IN FUSED SODIUM FLUORIDE. Haydée le Roux (Univ. of the Witwatersrand, Johannesburg). Nature **183**, 1180-1(1959) Apr. 25.

Strong fluorescence was observed for UO_3 , U_3O_8 , UO_2 , UF_4 , and $\text{UO}_2(\text{NO}_3)_2$ each fused with NaF in air at 1160°C . Further study showed that the fluorescent species obtained in fusion of UF_4 is not tetravalent. The fusions were repeated in Ar, and an initial fluorescence which appeared was attributed to O_2 leaking in. Variations in the violet region of the fluorescence spectra occurred according to atmosphere, concentration, time of fusion, and cooling rate. It is suggested that any U compound can be fused with NaF at 1200°C to form the same or similar species, with oxygen, moisture, and other atmospheric material present. (T.R.H.)

11652

SEPARATION OF ZIRCONIUM FROM CHROMIUM AND ALUMINUM BY ION-EXCHANGE CHROMATOGRAPHY. T. A. Belyavskaya and M. K. Chmutova. Nauch.

Doklady Vysshoi Shkoly Khim. i Khim. Tekhnol. No. 2, 305-7(1958). (In Russian)

In relatively dilute solutions of HCl , Zr is completely adsorbed when using the cationite KU-2. Under these conditions the adsorption of Cr is remarkably low, and Al is completely adsorbed from 0.1 N solution and practically not at all from HCl . A column is filled with KU-2 in the H-form, washed with HCl , and a solution containing chlorides of Zr, Cr, and Al is introduced. The column is then washed with HCl until complete removal of Cr. Zr is eluted with 4 N HCl . The distribution coefficient of Zr, Al, and Cr between the KU-2 and solution of HCl at different concentrations were determined. (TCO)

11653

THE DETERMINATION OF LOW OXYGEN CONCENTRATIONS IN SODIUM. W. Jahns and G. Weidmann (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonik **1**, 189-90(1959) Apr. (In German)

The possibility of determining low concentrations of oxygen in sodium was discussed. A simple amalgam method was described, and the solubility curve from it was given. (tr-auth)

11654

PREPARATION OF URANIUM COMPOUNDS. (To United Kingdom Atomic Energy Authority.) British Patent 801,380. Platinum Metals Rev. **3**, 34(1959) Jan.

A trivalent uranium compound is made by reducing a salt of uranium (valency of uranium higher than 4) by treating a solution of the salt with hydrogen in the presence of a Pt, Pd, or Rh catalyst.

11655

THE POTENTIALS OF INDIUM AND THALLIUM ON ELECTROLYSIS OF THEIR SALTS WITH A MERCURY ELECTRODE. P. P. Tsyb. Sbornik Trudov Vsesoyuz. Nauch. Issledovatel. Inst. Tsvetnoi Met. No. 1, 181-8(1956). (Translated from Referat. Zhur. Met. No. 4, 1958, p.334.)

The relationship between cathode and anode potentials (CP, AP) in the electrolysis of the aqueous salts of In and Tl with an Hg cathode relative to the amount of metal in the amalgam at different D and temperatures is discussed. It is established that the potentials required for deposition of In and Tl on an Hg cathode are more electropositive than their normal potentials and shift in the direction of the more electronegative values as the concentration of metal in the amalgam increases. As D increases, the CP of In shifts toward the electronegative values and the AP toward the electropositive. The CP of Tl is virtually independent of D. With rising temperature, the CP of In salt electrolysis shifts toward the more electropositive values, while the AP undergoes virtually no change. In the electrolysis of Tl salts, both the CP and the AP are virtually independent of temperature. Experiments in the electrolytic decomposition of the amalgam show that, under certain conditions, the In and Tl are almost completely extracted from the amalgam by electrolysis.

11656

CALCULATION OF THE MACROSCOPIC CROSS-SECTION OF HOMOGENEOUS MIXTURES. R. H. Weisser. Sulzer Tech. Rev. (Switz.) **40**, No. 3, 41-4(1958).

If homogeneous mixtures are to be used as moderators in a nuclear reactor, physical-chemical effects (such as volume contraction and exchange reactions)

must be taken into account in calculating the macroscopic cross section of such a mixture. Formulas are given which under certain conditions permit the macroscopic cross section of mixtures to be calculated from that of the pure components. (auth)

11657

CHEMICAL PROBLEMS IN THE HARNESSING OF NUCLEAR ENERGY. R. Walti. Sulzer Tech. Rev. (Switz.) 40, No. 3, 55-8(1958).

The exploitation of nuclear energy not only poses physical, metallurgical and design problems, but chemical questions also arise over the whole range of reactor engineering. They begin with the search for minerals containing fissile substances and end with "purification," i.e. the treatment of exhausted elements. (auth)

11658

DEVELOPMENT OF A PROCEDURE FOR REFINING ZIRCON INTERMEDIATES. L. G. Plaksina. Trudy Nauch. Issledovatel. Gornorazvedoch. Inst. "Nigrizoloto" No. 24, 116-22(1957). (Translated from Referat. Zhur. Met. No. 4, 1958, p.5.)

Various methods of milling, e.g., gravity, electrostatic, magnetic, and flotation, were studied for their applicability to the problem of refining zircon intermediates. Two procedures are described which resulted in extractions of 87.8 and 88.38 percent. (W.D.M.)

11659

THE FORMATION OF NITROGEN OXIDES IN THE SHOCK WAVE OF A STRONG EXPLOSION IN AIR. Yu. P. Raiser. Zhur. Fiz. Khim. 33, 700-9(1959) Mar. (In Russian)

The kinetics are examined of the formation of the nitrogen oxides NO and NO₂, and their distribution is calculated in air caught in a strong shock wave. An estimation is made of the total nitrogen oxidized during the strong explosion. It was shown that the nitrogen oxide does not form in fronts with temperatures below 2000°. The basic mechanism in the formation of the dioxide at temperatures above 2000°C was shown to be the process $\text{NO} + \text{O}_2 = \text{NO}_2 + \text{O}$, and the rate of this reaction was calculated with the aid of the activated complex method. The investigation was necessary to explain a number of optical phenomena observed in a strong explosion: glow of the shock wave at temperatures 7000° to 2000°, the breaking away of the wave front from the ball of fire and the characteristic intensity minimum of the latter. (auth)

11660

THE THERMOCHEMISTRY OF ISOTOPES. II. A STUDY OF THE HEATS OF FORMATION OF HYDROGEN AND DEUTERIUM SELENIDES. A. F. Kapustin-skii and R. T. Kankovskii (Mendeleev Chemical-Technological Inst., Moscow). Zhur. Fiz. Khim. 33, 722-6(1959) Mar. (In Russian)

The heats of formation of hydrogen selenide and deuterium selenide are 18.2 and 18.6 kcal, respectively, and the bond energies of hydrogen-selenium and deuterium-selenium are 67.2 and 67.9 kcal. (auth)

11661

A NEW METHOD OF ISOTOPE SEPARATION. G. M. Panchenkov, A. M. Tolmachev, and V. B. Kondratova (Lomonosov, Moscow State Univ.). Zhur. Fiz. Khim. 33, 734-5(1959) Mar. (In Russian)

A method of oxygen (enriched with O¹⁸O¹⁸) capture by crystalline cobalt compounds is described. The method can be used for isotopic separation of other elements in gaseous or liquid phases. (R.V.J.)

11662

THE ZIRCONIUM-URANIUM DIOXIDE REACTION. Presented at Nuclear Engineering and Science Conference, held at Chicago, March 17 to 21, 1958. Preprint 193, Session 9. Arnold F. Gerds, John W. Droege, Manley W. Mallett, and Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). New York, American Institute of Chemical Engineers, 1958. 34p.

The solid-solid reaction between zirconium and UO₂ was studied in the temperature range 750 to 2000°F. In the temperature range 750 to 1200°F, months of heating were required to produce measurable reaction zones. Easily measured reaction zones were produced in about 1 month at 1300°F and in a few hours at 1600 and 2000°F. A limited number of experiments indicated that Zircaloy-2 reacted less rapidly than zirconium with UO₂. The reaction of zirconium with UO₂ resulted in the dissolution of UO₂ in zirconium as uranium and oxygen. These diffused into the zirconium at unequal speeds. Zirconium diffused in the opposite direction to further the reaction. Reaction and diffusion rates were determined. (auth)

11663

ABSORPTION SPECTRA BETWEEN 0.8 μ AND 30 μ OF MIXTURES OF H₂O-D₂O IN THE LIQUID STATE.

M. Ceccaldi, M. Goldman, and E. Roth (Commissariat à l'Énergie Atomique, Paris). p.623-31 of "Colloquium Spectroscopicum Internationale VI (Amsterdam, 1956)." London, Pergamon Press Ltd.

There has been very little work carried out recently on the absorption bands of H₂O, HDO, and D₂O in the liquid state. The spectra of these molecules between 0.8 and 30 μ were established. The table of absorption bands of the molecules HDO and D₂O for which all the bands corresponding to those for H₂O had not been established was completed. A convenient method of representing the variations in optical density of certain HDO bands as a function of the concentration of heavy water in the mixtures studied was sought. (auth)

11664

THE EFFECTS OF LOCAL BOILING ON CORROSION AND CRUD DEPOSITION OF ZIRCALOY SURFACES.

Richard T. Esper and Walter E. Hopkins, Jr. (Westinghouse Electric Corp., Pittsburgh) and Clarence Jacklin and James H. Phillips (National Aluminate Corp., Chicago). p.697-708 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

Of major concern in pressurized water reactors are the effects of nucleate boiling on corrosion of fuel element cladding and crud deposition on reactor heat transfer areas. An out-of-pile program to investigate this effect on Zircaloy-2 is described. A brief description of the test procedure, the results of the various detailed examinations performed on the test specimens, and the resulting surface effects on Zircaloy-2 are presented. (W.D.M.)

11665

KORROZIYA KHIMICHESKOI APPARATURY. KORROSIONNOE RASTRESKIVANIE I METODY EGO

PREDOTVRASHCHENIYA. (Corrosion of Chemical Apparatuses. Corrosive Cracking and Method of Prevention.) G. L. Shvarts and M. M. Kristal. Moscow, State Scientific Technical Publishing House of Machine Building Literature, 1958. 204p.

The problems of intercrystalline corrosion taking place under static tension in various materials and alloys used in machines and apparatuses for chemical uses are discussed. The principle causes of such corrosion are discussed. Practical examples of deterioration of machinery in industry and methods for preventing corrosive deterioration of metals are described. The book was designed for technicians and technologists working in chemical machine building plants and in the chemical industry. (R.V.J.)

11666

ELECTROANALYTICAL CHEMISTRY. Second Edition, Revised and Enlarged. James J. Lingane. New York, Interscience Publishers, Inc., 1958. 680p.

The subjects covered in this volume are; common electrical measurements, interpretation of the EMF of galvanic cells, pH and its measurement, potentiometric acid-base titrations, potentiometric precipitation titrations, potentiometric oxidation-reduction titrations, automatic potentiometric titrations, conductometric analysis, electrolysis, polarographic analysis, amperometry and amperometric titrations, electrical instrumentation for controlled-potential electrolysis, technique of controlled-potential electrogravimetric analysis, controlled-potential electrogravimetric analysis procedures, controlled-potential electrolytic separation of metals prior to other determinative methods, internal electrolysis, electrographic analysis, controlled-potential coulometric analysis, coulometric titration with constant current, and chronopotentiometry. (W.L.H.)

11667

INSTRUMENTAL METHODS OF ANALYSIS. Third Edition. Hobart H. Willard, Lynne L. Merritt, Jr., and John A. Dean. Princeton, N. J., D. Van Nostrand Company, Inc., 1958. 632p.

The subjects covered by this volume are: visual colorimetry; photoelectric colorimetry; fluorescence and fluorescence methods; turbidimetry and nephelometry; ultraviolet and visible spectrophotometry; infrared spectrophotometry; emission spectrography and Raman spectrography; flame photometry; x-ray methods; mass spectrometry; refractometry and interferometry; polarimetry; thermal conductivity, gas chromatography, and other methods for the analysis of gases; radioactivity; nuclear magnetic resonance spectroscopy; potentiometric titration methods; pH measurements; electroanalysis methods; coulometric methods; polarography; amperometric titration methods; conductance methods; and enthalpy titrations. (W.L.H.)

11669

PROCESS FOR PRODUCING URANIUM TETRACHLORIDE. (To United Kingdom Atomic Energy Authority.) British Patent 812,121. Apr. 22, 1959.

A method and laboratory apparatus for making UCl_4 from UO_2 and CCl_4 are described. Hot CCl_4 vapor ($500^\circ C$) is passed over UO_2 powder at $450^\circ C$ to produce UCl_4 , CO , CO_2 , and $COCl_2$. Unreacted CCl_4 and $COCl_2$ are recycled until completion of the reaction. The apparatus consists of a tubular furnace with tubing for heating the CCl_4 and also for the reaction. (T.R.H.)

11669

IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE TRANSFER OF GRANULAR OR OTHER FINELY DIVIDED SOLID MATERIAL. Robert Lipscomb (to United Kingdom Atomic Energy Authority). British Patent 812,189. Apr. 22, 1959.

A valve is described which will permit transfer of powders or grains from one area to another without the two areas being interconnected. Two conical plates are arranged on a movable axis so that in the "up" position one plate engages a knife edge and in the "down" position a knife edge of the lower plate engages a seal surface. Thus, one area is connected with the valve's intermediate chamber at a time. (T.R.H.)

Radiation and Radiochemistry

11670 KAPL-M-HME-1

Knolls Atomic Power Lab., Schenectady, N. Y. THE DETERMINATION OF U-235 ENRICHMENT BY AN ALPHA COUNTING TECHNIQUE. H. M. Eiland and A. F. Heitkamp, Jr. Apr. 10, 1959. 16p. Contract W-31-109-Eng-52. \$3.30(pb), \$2.40(mf) OTS.

A method for determination of U^{235} in Zircaloy is presented. Total U in the sample is determined fluorometrically, and the U^{235} is measured by an alpha counting technique. The uncertainty of the technique is estimated as 15%. (J.R.D.)

11671 LS-23

Israel. Atomic Energy Commission, Tel-Aviv. LITERATURE SURVEY ON ISOTOPE SEPARATION. Nov. 1958. 26p.

This survey includes 199 references from the published literature on isotope separation. Physics Abstracts, Vol. 51 (1948) through Vol. 58 (1955), was the source. (J.E.D.)

11672 RDB(Cap)/TN-118

Gt. Brit. Capenhurst Works, Capenhurst, Ches., England.

IMPROVED TECHNIQUES FOR THE ANALYSIS OF THE ISOTOPES OF URANIUM WHEN USING MASS SPECTROMETERS. E. J. Robbins. [1954]. 7p. (CTSC/R-127).

Methods of improving the performance of MS2 mass spectrometers when used for hex analysis are presented. By increasing the sensitivity of the spectrometer and by fluorinating the copper ion box, the memory effect is reduced and the useful life of the ion box is increased. When using the single collection technique, the number of plant samples that may be measured before it becomes necessary to remove the ionization box for cleaning is increased from about 32 to 90 samples. The accuracy of the double collection enrichment technique is considerably increased. Details are given of the method of fluorination used to obtain this improvement. (auth)

11673

FORMATION OF HEXACHLOROETHANE FROM CARBON TETRACHLORIDE IRRADIATED BY γ -RAYS. B. I. Losev, M. A. Troyanskaya, and E. A. Bylyna (Inst. of Mineral Fuels, Academy of Sciences, U.S.S.R.). Doklady Akad. Nauk S.S.S.R. 125, 133-4 (1959) Mar. 1. (In Russian)

The products of coal chlorination formed by γ irradiation of mineral coal in carbon tetrachloride media were investigated. (R.V.J.)

11674

GAMMA SPECTROMETRY FOR ANALYSIS OF MIXTURES OF RADIOISOTOPES IN BIOLOGICAL AND MEDICAL RESEARCH. K. J. Öbrink and H. R. Ulfendahl (Univ. of Uppsala). Intern. J. Appl. Radiation and Isotopes 5, 99-105(1959) Mar.

With a single-channel pulse-height analyzer it has been possible to determine radioactive nuclides in mixtures even with very low activities. The amounts of each nuclide present have been calculated from the counting rates observed in fixed energy channels. This procedure is very simple and accurate provided pulse height amplification is extremely stable. It was again confirmed that a photomultiplier tube containing silver-magnesium dynodes cannot be used for accurate work of this kind. An RCA tube 6655 gave good results. Applications on mixtures of Cr^{51} - I^{131} and Na^{24} - K^{42} are described. (auth)

11675

STRESS-STRAIN PROPERTIES OF IRRADIATED FILLED NATURAL RUBBER. S. H. Pinner (Tube Investments Research Labs., Saffron Walden, Essex, Eng.). Intern. J. Appl. Radiation and Isotopes 5, 121-34(1959) Mar.

The stress-strain behavior of carbon-black filled natural rubbers cured by exposure to 2-Mev electrons was examined in relation to that of normal vulcanizates. A simple empirical power law relating modulus to elongation has facilitated handling of the experimental data. Antioxidants and other normal ingredients of the rubber mix confer improved ageing resistance but also increase the radiation dose required for a given modulus. Comparing radiation and sulfur cure, the former gives products adequate in modulus and ageing resistance but inferior in ultimate elongation for a given modulus and in tensile product. Special formulation may lead to improved products. (auth)

11676

A METHOD BY WHICH RADIOACTIVE MATERIAL MAY BE TRANSFERRED FROM A PAPER CHROMATOGRAM TO A PLANCHETTE. Reiner Svendsen (University Inst. for Experimental Medicine, Copenhagen). Intern. J. Appl. Radiation and Isotopes 5, 146-7(1959) Mar.

A one-step automatic method is described for the elution and transfer of radioactive materials from a paper chromatogram to a planchette for activity counting. (C.H.)

11677

F^{19} NUCLEAR MAGNETIC RESONANCE OF VARIOUS METAL-FLUORIDE COMPLEXES IN AQUEOUS SOLUTION. Robert E. Connick and Richard E. Poulson (Univ. of California, Berkeley). J. Phys. Chem. 63, 568-9(1959) Apr.

The chemical shifts of F^{19} have been observed for a number of metal fluoride complexes in aqueous solution. No simple correlation was found with the electronegativity of the metal ion or the stability of the complex formed. It appears that metal cations of high atomic number produce a strong decrease in the magnetic shielding and a rough correlation was obtained with A/d , i.e., ratio of the atomic number of the metal ion to the interatomic distance in the complex. In several cases separate resonances were observed, and assuming that they represent species which exchange fluorines only slowly, lower limits to the lifetime for exchange were calculated. (auth)

11678

RADIOASSAY OF AQUEOUS SOLUTIONS MIXED WITH SOLID CRYSTALLINE FLUORS. Daniel Steinberg (National Institutes of Health, Bethesda, Md.). Nature 183, 1253-4(1959) May 2.

A procedure is discussed for the direct radioassay of aqueous solutions of weak beta-emitting isotopes using a liquid scintillation spectrometer. The aqueous solution is mixed with a mass of finely divided beads of crystalline fluors. Addition of a detergent is essential to ensure prompt and uniform wetting of the crystals. Good results are reported using a blue-violet fluorescence-grade anthracene crystal. The method was successfully applied to solutions of proteins, glucose, amino acids, and sodium carbonate. (C.H.)

11679

THE DETERMINATION OF X RAYS AND PHOTO-CHEMICAL REACTIONS. Robert Wichard Pohl. Strahlentherapie 108, 356-60(1959) Mar. (In German)

All discussions in dosimetry should be based on the fact that the commercial ionization dosimeters do not determine a quantity, characteristic for a radiation field as it would be done by radiation intensity and irradiation intensity. Such a quantity can only be determined by dosimeters, absorbing the entire incoming radiation. By ionization dosimeters one gets only energy concentrations $\Delta W/\Delta m$ which are generated in irradiated air or in irradiated solids. Many errors and wasted discussions could be avoided if dose were not the reading at the scale of commercial dosimeters but a physical quantity defined by an equation. After this clearing up it is possible to use methods for studies of the biological effects of x rays which had been successful for the quantitative examination of photochemical reactions. (auth)

11680

THE INDIRECT EFFECTS OF X RADIATION ON AMINO ACIDS. G. Peter (Max-Planck-Institut für Biophysik, Frankfurt am Main). Z. Naturforsch. 14b, 135(1959) Feb. (In German)

X-radiation effects on lysine were investigated on 0.4, 0.04, and 18% water solutions. The average dose on the solution was 5.7×10^5 r/min. After irradiation, in addition to the unaltered lysine, a neutral fraction and a basic fraction were separated and investigated by paper chromatographic and electrophoretic methods. The variation in the composition of the basic and neutral fractions according to the concentration of the solution irradiated was shown. (J.S.R.)

11681

RADIATION METHOD FOR THE PRODUCTION OF PLATINUM CATALYSTS. A. A. Balandin, V. I. Spitsyn, L. I. Barsova, and V. I. Duzhenkov (Moscow State Univ. and Inst. of Physical Chemistry, Academy of Sciences, U.S.S.R.). Zhur. Fiz. Khim. 33, 736-7(1959) Mar. (In Russian)

The separation of metallic platinum from the saturated complex compounds $\text{Na}_2[\text{Pt}(\text{OH})_6]$ in 0.5 to 3N NaOH and $\text{Na}_2[\text{Pt}(\text{OH})_x\text{Cl}_{6-x}]$ in 2N NaOH was accomplished by irradiation with a fast electron flux. Further investigations of the radiochemical stability of complex heavy metal compounds and the methods for producing catalysts by irradiation are continued. (R.V.J.)

11682

METHOD OF ELECTROMAGNETICALLY SEPARATING IONIC ISOTOPES. (To United Kingdom Atomic Energy Authority.) British Patent 812,122. Apr. 22, 1959.

A source arrangement for an electromagnetic isotope separator is described. It consists essentially of two connected vacuum chambers, one in which vaporization occurs and another into which the vapor is passed and ionized. (T.R.H.)

Separation Processes for Pu and U

11683 CF-58-1-49

Oak Ridge National Lab., Tenn.

PROCESSING OF REACTOR FUELS IN MOLTEN

$3\text{ZrCl}_4 \cdot 2\text{PoCl}_3$, T. A. Gens. Jan. 6, 1958. Decl. Dec. 10, 1958. 7p. Contract [W-7405-eng-26]. \$1.80 (ph), \$1.80(mf) OTS.

Dissolution rates of approximately 10 mg/min-cm^2 have been obtained with all fuel alloys that have been tried. Uranium recovery of about 97% was achieved in the only run in which a material balance was obtained. A residue, insoluble in nitric acid, was found to contain up to 2.5% of the uranium that had dissolved in the melt. This quantity of uranium cannot be considered a loss unless further studies show that it cannot be dissolved by simple variation in technique. In the first experiment, the nitric acid contained half as much phosphate as uranium, by weight. A simple variation in procedure in the next experiment reduced the phosphate-uranium weight ratio to 1:50. Nichrome V seems to be a suitable and practical material of construction. (auth)

11684 CF-58-8-79

Oak Ridge National Lab., Tenn.

SHIELDING REQUIREMENTS FOR THE POWER REACTOR FUEL REPROCESSING PILOT PLANT.

J. P. Nichols. Aug. 29, 1958. 11p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

Shielding requirements for the Power Reactor Fuel Reprocessing Pilot Plant were determined as an aid to storage canal and building design. The recommendations are made so that plant personnel will not be exposed to a radiation dose rate in excess of one mr per hour during routine plant operation. Fuel assemblies in the storage canal should be covered with 12 ft of water. The dissolver charging machine should be covered with 12 in. of lead. The concrete cell wall should be 5 ft thick. (auth)

11685 DP-255

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

TURBINE CONTACTOR FOR SOLVENT EXTRACTION.

G. Starr Nichols. Dec. 1958. 24p. Contract AT(07-2)-1. \$0.75(OTS).

Test of a liquid-liquid contactor of commercial size showed that its performance was predictable on the basis of data previously obtained with a laboratory contactor having one fiftieth the volume. The criterion for composite performance of the mixer and settler was the heat conductance achieved at a given dispersion depth. (auth)

11686 DP-308

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

ANOMALOUS EXTRACTION OF ZIRCONIUM, NIOBIUM, AND RUTHENIUM BY TRIBUTYL PHOSPHATE.

Richard M. Wallace and Henry Pollock. Sept. 1958. 25p. Contract AT(07-2)-1. \$0.75(OTS).

The abnormally high extraction of Zr, Nb, and Ru by 30% tributyl phosphate, even when nearly saturated with

uranyl nitrate, is attributed to the presence of an organophilic carrier that is present in the initial HNO_3 solutions of irradiated U. The carrier remains in the organic phase making the desorption of these fission products from the organic phase a very slow process. Some evidence indicated that the carrier may be hydrated silica. Extraction of Zr, Nb, and Ru by TBP was reduced greatly by adding macroamounts of Nb compounds to the feed and precipitating Nb_2O_5 prior to solvent extraction. (auth)

11687 DP-346

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

PRECIPITATION OF MANGANESE DIOXIDE. James T. Grace, Hugh E. Henry, and David G. Karraker. Dec. 1958. 12p. Contract AT(07-2)-1. \$0.50(OTS).

The reaction of Mn^{2+} with MnO_4^- under vigorous agitation produces a precipitate of MnO_2 that can be more easily centrifuged from the supernatant than a precipitate formed under mild agitation. Increased temperature during precipitation also improved the ease of centrifugation. The effects are interpreted in terms of the kinetics of the precipitation. (auth)

11688 DP-348

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

CORROSION BY FLUORIDE SOLUTIONS. Woodfin E.

Shuler. Feb. 1959. 15p. Contract AT(07-2)-1. \$0.50(OTS).

A number of alloys were tested for resistance to corrosion in HF and HNO_3 and mixtures of the two acids. The austenitic stainless steels and the higher chrome-nickel alloys of iron were most promising. Of the materials tested, stainless steel, type 309Cb, Carpenter 20, Durco D-10, Durimet 20, and Chlorimet 3 were the most resistant to separate solutions of HF and HNO_3 . Each of these alloys showed a significant increase in corrosion rate with increase in temperature. Exposure to HNO_3 appeared to passivate Carpenter 20 toward HF. In the mixed acids, fluoride ion increased markedly the rate of corrosion of all materials tested. The corrosion data indicate that the use of HF or acidic fluoride solutions will require relatively frequent replacement of dissolver vessels. Stainless 309Cb appeared to be the best of the tested materials considering ease of fabrication, compatibility with the processing of other fuel elements that are dissolved with nitric acid, and corrosion resistance. (auth)

11689 IDO-14452

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CONTINUOUS DISSOLVER THEORY. III. DEVELOPMENT OF GENERAL TANK-FLOW RELATIONSHIPS WITH APPLICATION TO PILOT PLANT DATA FOR A FLOODED COLUMN DISSOLVER. E. E. Erickson. Apr. 1, 1959. 34p. Contract AT(10-1)-205. \$1.00(OTS).

General relationships are developed for the performance of continuous flooded dissolvers based on complete mixing, such as tank flow, uniform packing characteristics of metal, and a first-order rate law. The form of the final equation is the same as that derived for the non-mixing or tube-flow case discussed in earlier reports of this series, with differences appearing only in the term that expresses the concentrations of metal and dissolver in the liquid phase. The relationships are applied to available pilot plant data on the mercury-catalyzed dissolution of four shapes of 28 aluminum elements. The

data cover a range of catalyst concentrations from 1.5×10^{-6} to 3.75×10^{-4} molar Hg^{2+} and metal bed heights from 1 to 10 feet in a 2-inch pyrex column. The average initial dissolvent concentration was 5.6M nitric acid. Round rods, flat plates, tubes, and flattened tubes are compared. The data for the round rods are utilized to determine the effective reaction velocity constants at the various catalyst concentrations. The general dissolver equation is used to predict the effect on dissolution rate of the shape of metal elements, liquid phase flow rate, and height of the bed of elements. Calculated rates follow the trends in the data, but not quite so well as calculated rates for the nonmixing or tube-flow case. The mathematical representation of the model is generally consistent with the pilot plant data. (See also IDO-14450 and IDO-14451.) (auth)

11690 NAA-SR-Memo-729

North American Aviation, Inc., [Downey, Calif.]. THE HIGH TEMPERATURE SEPARATION OF PLUTONIUM AND FISSION PRODUCTS FROM IRRADIATED URANIUM CARBIDE. Charles R. F. Smith. July 10, 1953. Decl. Nov. 6, 1958. 18p. \$3.30(ph), \$2.40(mf) OTS.

A brief study was made on the high-temperature diffusion of tracer plutonium and fission products from uranium carbide. Uranium carbide powder was pressed into small pellets and sintered in vacuo at about 1900°C. The pellets were neutron irradiated in the Los Alamos Water Boiler and were placed inside graphite susceptors. They were then heated by induction in vacuo and in argon for periods of 40 to 200 minutes at average temperatures ranging from 2300 to 2625°C. Analyses of the material remaining after heating showed that up to 90% of the plutonium, 85% of the gross beta activity, and 28% of the gross gamma activity were removed. Up to 8% loss of uranium was also observed but this could be minimized by carefully controlling maximum firing temperature. (auth)

11691 NAA-SR-Memo-746

North American Aviation, Inc., [Downey, Calif.]. EXTRACTION OF POLONIUM FROM MOLTEN BISMUTH WITH FUSED SODIUM HYDROXIDE. Rex A. Barney. July 20, 1953. Decl. Nov. 6, 1958. 3p. \$1.80(ph), \$1.80(mf) OTS.

Experimental data show that tracer polonium can be quantitatively separated from bismuth at 500°C. The process is applicable to a reactor using bismuth as a coolant. At the end of a run the sodium hydroxide and bismuth are separated and the polonium determined from the alpha activity. The results of several runs are tabulated. (J.E.D.)

11692 TID-3312

Technical Information Service, AEC. REPROCESSING OF IRRADIATED FISSION REACTOR FUEL AND BREEDING MATERIALS. AN ANNOTATED BIBLIOGRAPHY OF SELECTED REPORT LITERATURE. James M. Jacobs, comp. Nov. 1958. 121p. \$2.75(OTS).

A total of 713 annotated references to the unclassified report literature is presented. Subject, author, and report number and availability indexes are included. (auth)

11693 AEC-tr-3645

METHOD IN THE PREPARATION OF URANIUM METAL. Translated for Mallinckrodt Chemical Works from Swedish Patent No. 157,612. Inventor: J. H.

Mogard. [Patent] Granted, Nov. 15, 1956. 12p. \$3.30(ph), \$2.40(mf) JCL or LC.

A method for the production of U metal from UF_4 by metallothermal reduction with Mg in a salt fusion bath is described. The process is suited for production of U in large and small quantities, and an open crucible can be used to obtain either solid or liquid U metal. (J.R.D.)

11694

THE PILOT PLANT FOR ISOTOPE CONCENTRATION OF URANIUM HEXAFLUORIDE BY GASEOUS DIFFUSION. H. Albert (Société de Recherches techniques et industrielles, Paris). Bull. inform. sci. et tech. No. 26, 2-8(1959) Feb. (In French)

The gaseous diffusion pilot plant for uranium isotope concentration constructed at Saclay is described. The characteristics, as well as the stages of its development, are discussed. (J.S.R.)

11695

REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 2, No. 2. Lemont, Ill., Argonne National Laboratory, 1959. 42p. Available from U. S. Government Printing Office, Washington for \$0.55 (domestic); \$0.70 (foreign).

Firms making proposals under the AEC fuel-cycle program are listed with the number of proposals submitted. Fuel data and cost factors are tabulated for four commercial power reactor stations and the Shippingport Plant. A review of a serious criticality incident at Los Alamos is given. Developments in head-end mechanical and chemical processing are discussed including removal of Zr and Zircaloy jackets as well as stainless steel. Recovery of U from Zr fuel elements continues as an unsolved problem because of sublimation with ZrCl_4 . Progress in dissolution of stainless steel in the Darex process is reported as well as nitric acid dissolution of U-Mo alloys. Developments and improvements in the Purex process such as near-quantitative recovery of Np in first-cycle extraction are reported. A solution of tri-n-octylphosphine oxide (TOPO) in cyclohexane was reported as an excellent extractant for Th from chloride or nitrate solutions, but not from sulfate. Data on stability of Purex diluents exposed to chemical degradation are presented. Also, graphs illustrating nuclear safety for Pu^{239} , U^{235} , and U^{233} are presented. Ion exchange separation of Cs from alkaline solution is discussed, and methods of fission product separation from U and Pu are reported. A flowsheet for Pu recovery and decontamination is presented as well as a two-cycle anion exchange flowsheet for processing Pu reactor fuels and Excer process treatment for recovery of U. Developments on inter-halogen- UF_6 separations and fused-salt processing studies are reported, and data are presented from analyses of vapor samples taken from the BrF_5 - UF_6 packed column separator. Discussions of research in pyrometallurgical processing are included in such aspects as melt refining, processing of Pu-rich fuels, UO_2 fuel, and liquid metal processes. Information from HRT run 16 summary is presented including fission product activity distribution data. Corrosion in fissionable material recovery in such environments as Sulfex and Thorex, fused-salt volatility processes, and data on corrosion in NaF - ZrF are presented. Waste disposal discussions are presented with emphasis on the congressional hearings, operating experience, and

final disposal methods. A description of the UF_6 plant at Metropolis, Ill., is given in which 70% U_3O_8 is reduced to UO_2 and hydrofluorinated to UF_4 and fluorinated to UF_6 ; a flowsheet is included. Production of UF_4 from UO_2 and from various ores is discussed, and U recovery operations from scrap as well as from UF_6 vent gases are examined. (J.R.D.)

11696

METHOD OF RECOVERING URANIUM. (To United Kingdom Atomic Energy Authority.) British Patent 812,794. Apr. 29, 1959.

A procedure for recovering U from calutron wash solutions is given. The hot water wash containing UCl_4 and traces of the components of stainless steel is treated with H_2O_2 , then insoluble material is filtered out. Electrolysis is used to reduce the UO_2^{2+} to U^{4+} which is then precipitated as oxalate and filtered and washed. The procedure involves mixing and washing techniques to ensure thorough separation and recovery of U of various degrees of enrichment from various stages in the calutron process. (T.R.H.)

11697

IMPROVEMENTS RELATING TO THE RECOVERY OF URANIUM FROM SOLUTIONS. Theodore Roger, Ernest Kressman, and John Robert Millar (to The Permutit Co., Ltd.). British Patent 812,815. Apr. 29, 1959.

An ion exchange method for separation of U from solutions is described. It is based on the fact that cation exchange materials containing carboxyl groups have a high affinity for UO_2^{2+} to the exclusion of other mono- and divalent cations. Suitable materials suggested are copolymers of methacrylic acid and divinyl benzene and condensation products of phenol and formaldehyde treated with chloracetic acid. The only limitation on pH for the process is that imposed by the necessity for having the U in the UO_2^{2+} state. The U can be separated from very dilute solutions by continued flow over the ion exchanger for a sufficient time. (T.R.H.)

CONTROLLED THERMONUCLEAR PROCESSES

11698 AERE-GP/R-2035

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

TIME-RESOLVED ION TEMPERATURE MEASUREMENTS IN A HIGH CURRENT GAS DISCHARGE. A. H. Turnbull and B. B. Jones. Aug. 17, 1956. Decl. Apr. 30, 1959. 13p.

By means of a rotating shutter technique, a pulsed toroidal discharge of 500 microseconds duration has been examined in five 100 microsecond sections. Ion temperatures were measured spectroscopically by a technique previously reported. It was found that the ion temperature rose steadily for 250 to 300 microseconds and then became constant for the remainder of the pulse. (auth)

11699 NYO-7995

Princeton Univ., N. J. Project Matterhorn. CYCLOTRON DAMPING OF AN IDEAL PLASMA. Tech. Memo. 56. Thomas H. Stix. Nov. 21, 1957. Contract AT(30-1)-1238. \$3.30(ph), \$2.40(mf) OTS.

Small-amplitude oscillations of ions moving perpendicular to the lines of force are considered for a fully ionized gas in a magnetic field. Particle collisions are neglected, and the temperature of the gas corresponding to motions perpendicular to the lines of force is assumed to be zero. The temperature of the ions is taken to be finite. Oscillations which are periodic in distance along the lines of force and in time are considered. (W.D.M.)

11700 UCRL-8153

California. Univ., Berkeley. Radiation Lab. THE TRIAX PINCH DEVICE. O. A. Anderson, W. R. Baker, J. Ise, Jr., W. B. Kunkel, R. V. Pyle, and J. M. Stone. Jan. 1958. 42p. Contract W-7405-eng-48. \$1.25(OTS).

The Triax device is a discharge tube in which a plasma carrying a current is pinched into the form of a cylinder between two concentric copper cylinders, each of which carries part of the return current. Such a geometry has attractive features from the standpoint of stability. An extensive study of the Triax discharge was carried out in which observations with magnetic probes, spectrographs, and efficient neutron detectors were combined with measurements of current and voltage to give much information on the behavior of the plasma. It is clearly established that a well-pinch sheet plasma is formed. Neutrons, up to 2×10^5 per pulse, emerge in a short burst that coincides in time with the sudden appearance of strong light from impurities and also coincides with a peculiar bump in a plot of the voltage across the tube. The nature of the neutron production was not established, and although certain arguments are presented that make it not inconceivable that it is thermonuclear, a search for a nonthermonuclear origin is continuing. The importance of a suitable auxiliary starting discharge in forming neutron-producing pinches with very high currents is brought out. Advances in the art of switching large currents are described. (auth)

11701 UCRL-8579

California. Univ., Berkeley. Lawrence Radiation Lab. THE ION MAGNETRON. J. Donald Gow, Lloyd Smith, and John M. Wilcox. Feb. 1959. 15p. Contract W-7405-eng-48. \$0.50(OTS).

The ion magnetron is an experiment in which a plasma is created in a geometry similar to that of the well-known electron magnetron tube. An electron sheath forms about the central anode, and most of the applied-voltage drop occurs in this sheath region. Ionization of neutral molecules in the sheath provides an irreversible mechanism for injecting high-energy ions into the containment region. Experimental observations on the device are described, followed by a short discussion of some of the processes involved in its operation. (auth)

CRITICALITY STUDIES

11702 DP-312

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

INTERACTION OF SUBCRITICAL COMPONENTS. Hugh K. Clark. Nov. 1958. 48p. Contract AT(07-2)-1. \$1.50(OTS).

A simple, generally conservative, and reasonably accurate method is developed for computing safe spacings of vessels containing fissile material, such as those encountered in separations process equipment. Simplifying assumptions are made to permit the fraction of the neutrons escaping from one component that enters

another to be obtained by a purely geometric calculation, independent of the details of the flux distribution. For each component the albedo and the effective reflector saving provided by the other components are expressed in terms of these fractions. Interactions between slabs (both parallel and perpendicular), between cylinders, interactions with reflectors, and self-interactions in the case of annuli are considered. Comparisons with experiments are made. (auth)

GEOLOGY AND MINERALOGY

11703 LS-18

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON AERIAL PROSPECTING
FOR GROUND RADIOACTIVE MATERIAL. Oct. 1958.
6p.

Thirty-nine references from report and published literature on aerial prospecting are given. Sources considered include Nuclear Science Abstracts, 1951 to June 1958, and Geneva Conference Proceedings, 1955. (L.T.W.)

11704

REVIEW OF HYPOTHESIS ON THE ORIGIN OF URANIUM DEPOSITS. V. I. Makkelvi, D. L. Everkhart, and R. M. Garrels. Geol. Atom. Syr'evykh Material. Sbornik, 25-52(1956). (Translated from Referat. Zhur. Geol. No. 7, 1957, p.135-6.)

The basic characteristics of the most important industrial deposits of U are examined, and some problems of their origin are reviewed. The following groups of deposits are distinguished: uranium-bearing volcanic rock, pegmatites, and migmatites; U in hydrothermal veins and metasomatic deposits; U deposits in sandstones; uranium-containing coal and associated carbonaceous shales; uranium-containing black shales; and uranium-containing marine phosphorites.

11705

C¹⁴ AGE DETERMINATION OF FRESH WATER LIME DEPOSITS. K. O. Münnich and J. C. Vogel (Univ. of Heidelberg, Ger.). Naturwissenschaften 46, 168-9 (1959). (In German)

It has been shown that the C¹⁴ content of recent hard water is approximately 85% of that found in new wood. For the age determination of lime deposits, it must be assumed that initial C¹⁴ content of deposited lime must not vary from the 85% value. The possible causes of deviations from this value are discussed, and the corrections to be made are described. (J.S.R.)

11706

RADIOACTIVITY AND URANIUM CONTENT, SHARON SPRINGS MEMBER OF THE PIERRE SHALE, KANSAS AND COLORADO. E. R. Landis. U. S. Geol. Survey Bull. 1046-M. 24p. 4 illus. \$0.70(GPO)

A reconnaissance of the Sharon Springs member of the Pierre shale of Late Cretaceous age in western Kansas and eastern Colorado was made during 1954. The Sharon Springs member of the Pierre shale and its lateral equivalents range from 155 to about 500 feet in thickness and generally contain about 0.001 percent uranium, but some beds contain larger amounts. A 6-foot shale bed in Cheyenne County, Colo., contains about 0.006 % uranium; a 4½-foot sequence of beds in Crowley County, Colo., is estimated to contain between 0.004 and 0.005 % uranium; and a 3½-foot sequence of beds in Kiowa County, Colo., contains about 0.004 %

uranium. At several outcrop localities, sequences of beds as much as 9½ feet thick contain about 0.003 % uranium. Data from wells indicate that the 4½-foot thick sequence of beds in Crowley County, Colo., may have a lateral extent of at least 5½ miles. A gamma-ray log of a well in Yuma County, Colo., indicates a sequence of beds 66 feet thick which contains 0.005 to 0.010 % equivalent uranium. No definite pattern of areal distribution of radioactivity and uranium content in the Sharon Springs is indicated by available data. Subsurface data from gamma-ray logs of wells indicate however that both the maximum radioactivity and the thickness of radioactive beds are variable within distances of a few miles. Most of the gamma-ray logs show that only part of the sequence of rocks comprising the Pierre shale and Niobrara formation exhibits radioactivity in excess of the average radioactivity of the two formations. Comparison of gamma-ray logs of wells in northeastern Colorado suggests that the most radioactive parts of the Pierre shale and Niobrara formation are a laterally correlatable sequence of beds. The stratigraphic position of the radioactive unit relative to the Pierre shale-Niobrara formation contact in oil industry scout reports, as identified from electric logs of wells, is variable within short distances. This may indicate that some of the Pierre-Niobrara contacts picked from electric logs may not correspond to the boundary that would be selected by examination of the rocks themselves, or it may indicate a facies relationship between the lowermost part of the Pierre shale and the uppermost part of the Niobrara formation. (auth)

HEALTH AND SAFETY

11707 AECU-4074

Knolls Atomic Power Lab., Schenectady, N. Y.
CRITERIA FOR PRE-STARTUP ENVIRONMENTAL MONITORING PROGRAMS FOR NUCLEAR SITES. R. J. Feinberg. Sept. 1957. 24p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

The need for a pre-operational site survey is discussed, and the information which should be obtained is outlined. A pre-startup survey would permit evaluation of the effect of the operation on its environs, would result in design and construction savings, and would allow a liability assessment. Background monitoring should include air, water, and ground measurements. Examples of survey programs cited are those at Savannah River and Brookhaven. The usefulness and requirements of a meteorological survey are also discussed. (T.R.H.)

11708 AECU-4089

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.
A URANIUM INHALATION EXPOSURE CASE HISTORY. [nd]. 4p. \$1.80(ph), \$1.80(mf) OTS.
Condensed version of Y-B94-54.

A machinist in a U shop was found to have inhaled dust from his work. The exposure resulted from the worker's keeping his face close to the work thereby interfering with the exhaust provided. Also, at some time during the period some cleansing tissues were drawn into the exhaust duct and lodged there. An initial lung burden of 3 to 5 mg was found with no evidence of kidney loading. Excretion was primarily in the urine, 2.33 mg being detected in urinalyses for 2.54 mg being eliminated from the deposit. The employee suffered no deleterious effects, felt well, and had no complaints. (T.R.H.)

11709 DC-53-5-14(Del.)

General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati.

A METHOD OF ANALYZING RAINOUTS. James H. Bick and John A. Weaver. [1953]. Decl. Apr. 22, 1959. 16p. \$3.30(ph), \$2.40(mf) OTS.

A method was developed for determining radiation doses resulting from a rainout of fission fragments from a reactor accident. Sample rainouts are calculated for three different values of the diffusion parameter in Sutton's equation. The basic conclusion drawn from a comparison of dosage from rainout or from over-head clouds is that rainout is not the most important contributing factor to radiation hazards. In certain marginal cases, rainout plus cloud radiation may lead to lethal doses. (W.D.M.)

11710 DP-92

Du Pont de Nemours (E. I.) & Co., Savannah River Lab., Augusta, Ga.

RADIOACTIVITY IN THE ENVIRONS OF THE SAVANNAH RIVER PLANT, JANUARY TO JULY 1954. J. H. Horton. Nov. 1954. Apr. 27, 1959. 27p. Contract AT(07-2)-1. \$4.80(ph), \$2.70(mf) OTS.

There were significant increases in radioactivity in the environs of the Savannah River Plant during the period from January 1954 to July 1954. All of these increases were relatively small as compared to the maximum permissible concentration. Although fall-out from Pacific tests was the main contributor to the increased activity, some of the increase was due to normal Plant operations. (W.D.M.)

11711 GAT-R-171

Goodyear Atomic Corp., Portsmouth, Ohio.

HEALTH AND SAFETY ACTIVITIES REPORT FOR 1958. Apr. 13, 1959. 76p. Contract AT(33-2)-1. \$12.30(ph), \$4.50(mf) OTS.

The health and safety activities at Goodyear Atomic Corporation and some of the statistics compiled during calendar year 1958 are reported. Both the frequency rate (1.78) and the severity rate (258.78) for disabling injuries for 1958 are below the averages for the Chemical industry and Atomic Energy Commission's operations. The plant motor vehicle accident frequency rate has reached a new low and the average number of fire incidents was held to a minimum. Health and safety services such as medical examinations, safety glasses, urinalyses, noise level surveys, equipment inspections, and radiation control were provided on a continuing basis, and the results of plant-wide safety performance were indicative that all of these services were economically justifiable. (auth)

11712 HASL-28

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM SUMMARY REPORT FOR MARCH 1958. Edward P. Hardy, Jr. 64p. \$10.80(ph), \$3.90(mf) OTS.

Strontium-90 levels in fall-out collected in pots and tubs at New York City, Pittsburgh, Chicago, and other U. S. and foreign sites are reported for Feb. 1958. Data are reported on levels in powdered milk from Perry, New York, and liquid milk for New York City and other U. S. sites. New York City tap water was analyzed for strontium-90 content. (W.D.M.)

11713 HASL-55

New York Operations Office. Health and Safety Lab., AEC.

STRONTIUM PROGRAM. Quarterly Summary Report. Edward P. Hardy, Jr. and Stanley Klein. Feb. 24, 1959. 109p.

Data collected by the Health and Safety Laboratory between Nov. 1, 1958, and Jan. 30, 1959, on Sr⁹⁰ in fall-out, milk, tap water, vegetation, and foods are given. Data from the U. S. Public Health Service and the Physicalisches Institut der Bundesforschungsanstalt für Milchwirtschaft are included along with a Food and Drug Administration summary of their work. (See also HASL-51.) (T.R.H.)

11714 HASL-S-1

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT (FOR) MARCH 30 TO JULY 30, 1954. Sept. 1, 1954. Decl. Apr. 22, 1959. 16p. \$3.30(ph), \$2.40(mf) OTS.

World-wide fall-out as measured at 96 stations continued during the months of June and July. Values ranged from 0.47 to 16 millicuries per square mile per month. Fall-out analyzed at three stations during the months of June and July showed from 0-1.8% Sr⁹⁰ content. A comparison of gummed paper with a high-walled stainless pot was made. The data show extreme variability and the experiment is being continued with duplicates of each method. The Sr⁹⁰ content of wet and dry milk showed a rise to 6.1 d/m/qt during early July. August values are below 1 d/m/qt. Upper air samples taken near the test site prior to Castle showed Sr⁹⁰ to total activity percentages of from 0.8 to 3.9. (auth)

11715 HASL-S-2

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT, AUGUST 1954. Nov. 12, 1954. Decl. Apr. 22, 1959. 14p. \$3.30(ph), \$2.40(mf) OTS.

World-wide fall-out values ranged from 0.16 to 34 mc/mi²/mo. Comparison of gummed paper with a high-walled stainless pot continued to show extreme variability. Sr⁹⁰ content of wet and dry milk, air at various levels, tap water, and urine samples was determined. (W.D.M.)

11716 HASL-SC-1

New York Operations Office. Health and Safety Lab., AEC.

PRELIMINARY COOPERATIVE SUNSHINE REPORT. Oct. 26, 1954. Decl. Apr. 22, 1959. 11p. \$3.30(ph), \$2.40(mf) OTS.

In order that the results reported from each of three laboratories may be used to evaluate Sr⁹⁰ distribution, a cooperative program has been in operation since August of 1953. This preliminary report lists the results on samples received and distributed by HASL. It is hoped that complete results from all laboratories will be available soon. The cooperative samples were run by the methods currently in use by each laboratory. At HASL, Ca values were obtained by flame photometry for each sample. Sr⁹⁰ samples were standardized against NBS Sr⁹⁰-Y⁹⁰ carried through the chemical procedure. (auth)

11717 HW-20810

Hanford Works, Richland, Wash.

RADIOACTIVE PARTICLES IN THE ATMOSPHERE, JANUARY 1951-MARCH 1951. W. Singlevich. Apr. 12, 1951. Decl. Apr. 24, 1959. 30p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

Filter papers received from various western locations after the 1951 tests in Nevada indicated the presence of

active particles at all locations monitored. The results of monitoring at each station are included in tabular form showing the active particle collection from day to day. Maximum particle count ($3.62/\text{m}^3$) was recorded at Salt Lake City Feb. 4-5, 1951. (W.D.M.)

11718 HW-24727

Hanford Works, Richland, Wash.

MONITORING SURVEY—RICHLAND TO ARCO, PERIOD MAY 9-11, 1952. J. F. Honstead. June 20, 1952. Decl. Apr. 24, 1959. 14p. Contract W-31-109-eng-52. \$3.30(ph), \$2.40(mf) OTS.

A cargo truck, on a routine trip from Arco, Idaho, to Hanford was found contaminated on arrival. A monitoring trip was organized to cover the truck route in an attempt to find the location of the contaminating region. It was concluded that the radioactive material responsible for contamination of the truck was brought down from a radioactive cloud resulting from a test atomic blast at Yucca Flats, Nevada. The estimated trajectory of the plume from the blast and meteorological data for the period are included. Monitoring data for the area surveyed are tabulated. (C.H.)

11719 ICF-1000

Idaho Operations Office, AEC.

SITE SURVEY MONITORING OF ANP—IET OPERATIONS, APRIL 19 THROUGH JULY 2, 1956. Decl. Apr. 27, 1959. 12p. \$3.30(ph), \$2.40(mf) OTS.

The IDO Health and Safety Division monitored all areas beyond G. E. jurisdiction which could possibly be affected by Initial Engine Test operations over the test period. All releases of activity were detected in the month of June. Various locations were monitored by G-M counters, fall-out plates, film badges, CFM filters, and sky scanners. No significant releases were detected. (W.D.M.)

11720 ITR-1177

California, Univ., Los Angeles. Atomic Energy Project.

THE FACTORS INFLUENCING THE BIOLOGICAL FATE AND PERSISTENCE OF RADIOACTIVE FALL-OUT. R. G. Lindberg, E. M. Romney, J. H. Olafson, and K. H. Larson. Aug. 1955. Decl. Apr. 22, 1959. 72p. Project 37.1 [of] OPERATION TEAPOT. \$12.30(ph), \$4.50(mf) OTS.

A study was made of the biological fate and persistence of radioactive fall-out as they were affected by the physical characteristics of fall-out contamination. Data indicate that the activity measured in plant samples collected from fall-out areas is the result of external contamination by radioactive particles less than 44 microns in diameter. It is concluded from the study of animals that the principal source of activity in tissues is from ingestion through the digestive tract. (W.D.M.)

11721 ITR-1185

New York Operations Office. Health and Safety Lab., AEC.

MEASUREMENTS OF BETA AND GAMMA RAY CHARACTERISTICS OF SHOT DEBRIS AND FALL-OUT OF NUCLEAR WEAPONS. Preliminary Report. H. D. LeVine and R. T. Graveson. [1955]. Decl. Apr. 22, 1959. 46p. Project 30.3 [of] OPERATION TEAPOT. \$7.80(ph), \$3.30(mf) OTS.

Development and field testing, during the Teapot series, resulted in a group of instruments useful for study of the radiation characteristics of fall-out debris. An aerial survey detector with automatic altitude com-

pensator and a telemetering unit were completed and tested. (W.D.M.)

11722 ITR-1515(Del.)

Sandia Corp., Albuquerque, N. Mex.

SUMMARY REPORT, TEST GROUP 57. Operation PLUMBBOB—Preliminary Report. J. D. Shreve, Jr. Apr. 1958. Decl. with deletions Apr. 24, 1959. 143p. \$13.50(ph), \$4.80(mf) OTS.

On April 24, 1957, Operation Plumbbob Test Group 57 conducted a detonation of a device for the purpose of studying the plutonium hazards from accidents. The objectives were to estimate the immediate and long-term distribution of plutonium and gain an understanding of how this distribution comes about, to conduct a biomedical evaluation of plutonium-laden environments, to investigate relevant methods of decontamination, and to evaluate alpha field survey instruments and monitoring procedures. In the order mentioned, these objectives define four programs designated as 71, 72, 73, and 74, respectively. The results of Program 74 show that field survey methods can be relied upon to delineate the areas contaminated by an accident, and the results of Program 73 show that decontamination can be carried out successfully. Through analyses of collecting pans, Program 71 determined the areas covered by significant levels of contamination. Strictly speaking, these particular contours are only valid for the particular wind structure which was obtained at the time of the shot, but it is expected that a basic fallout model will be prepared from these data which will permit extrapolation to other wind conditions. Air samplers indicated high airborne concentrations of respirable plutonium remarkably for downwind. Nevertheless, the amounts of plutonium picked up by animals exposed by Program 72 do not seem excessive. A full evaluation of these animal data has yet to be carried through, since the biological processes being studied are very slow. (auth)

11723 KAPL-1964

Knolls Atomic Power Lab., Schenectady, N. Y.

RADIOLOGICAL DEVELOPMENT ACTIVITIES IN HEALTH PHYSICS. Semiannual Progress Report [for] January-June 1957. L. J. Cherubin and J. J. Fitzgerald. 33p. Contract W-31-109-Eng-52. \$1.25(OTS).

A Total Activity Detector for air samples was designed to provide the means whereby individual absorption correction factors for alpha and weak beta counting of filter papers are automatically accounted for and integrated into a final measurement. Criteria for effective air sampling were developed. The development of the individual beta pocket dosimeter led to the design, construction, and evaluation of a combined beta, gamma, and thermal neutron pocket dosimeter. The latter dosimeter, called a Universal Pocket Dosimeter, can also be adapted to eye and hand monitoring. A total neutron personnel dosimeter was designed to detect thermal and fast neutrons. Experimental and theoretical analyses of the total neutron dosimeter are in progress. To aid in the development of thermal neutron dosimeters, the Sigma Pile Substitute, a water-moderated thermal neutron calibration facility, was calibrated with Ra-Be and Pu-Be sources. Dose rates of 0.18 and 0.56 mrem/hr can be detected in this unit, with sources of 50.8 mg Ra-Be and 15.19 gm Pu-Be, respectively. Studies were continued to determine the rate of accumulation and the distribution of radioactive materials in aquatic life as

related to radioactive materials released into a surface stream. The data indicate that specimens of fry are the most sensitive specimens of those analyzed with respect to reflecting the transient concentrations of radioactive materials in the stream. An ion exchange analysis was established for Sr^{90} in water—concentrations of greater than 3×10^{-10} μC Sr^{90}/cc water can be detected. This procedure was adapted to Mohawk River monitoring. Studies of the activity in the edible portion of fish tissue have indicated the average K^{40} concentration to be approximately 7 d/m/gm of tissue. Improvements in the area of reactor safeguards were concentrated on the development of less restrictive and more realistic exclusion area formulas and on the summarization of reactor risks. (For preceding period see KAPL-1887.) (auth)

11724 KAPL-1991

Knolls Atomic Power Lab., Schenectady, N. Y.
HEALTH PHYSICS REPORT [FOR] APRIL, MAY, JUNE 1958. W. H. Truran, comp. 34p. Contract W-31-109-Eng-52. \$1.25(OTS).

No exposure of personnel to external or internal irradiation occurred which exceeded quarterly limits recommended in NBS Handbook 59. A total of 5.5 c of fission products was released to the Mohawk River without adverse effect on the utilization of the river for recreational purposes, power generation, or drinking water supply. Less than 850 mc of fission products were released to the atmosphere from KAPL exhaust stacks. This represents an increase of two orders of magnitude over the previous reporting period; which is due, for the most part, to an incident in the Radioactive Materials Laboratory. Environmental radiocontamination levels, with the exception of radioiodine as a result of the RML incident, followed previously observed patterns. An increase in the radioactivity level in precipitation of two orders of magnitude in June was attributed to outside influences and compared with activity levels observed in precipitation at the West Milton Site in April of 1957. To avoid the recurrence of similar contamination problems a modified liquid waste operation which provided for the removal, evaporation, and off-site disposal of liquid radioactive waste to be stored in underground tanks was recommended to the General Manager. A method was developed for the determination of strontium-90 beta radioactivity in water with a sensitivity level of 1.6×10^{-4} μC Sr/ml water. (auth)

11725 KAPL-M-BBB-2

Knolls Atomic Power Lab., Schenectady, N. Y.
DESIGN CRITERIA FOR THE TYPE M-130 STANDARDIZED SHIELDED SHIPPING CONTAINER. B. B. Biggs. Jan. 17, 1958. 10p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The design objectives and criteria for the Type M-130 shielded shipping container are presented. The information is presented to ensure compatibility with spent fuel modules. (auth)

11726 KAPL-M-LJC-6

Knolls Atomic Power Lab., Schenectady, N. Y.
KAPL ENVIRONMENTAL CONTAMINATION PATTERN DUE TO KAPL OPERATIONS AND OUTSIDE INFLUENCES. L. J. Cherubin. Apr. 1954. 56p. Contract W-31-109-Eng-52. \$7.80(ph), \$3.30(mf) OTS.

Contamination of the Knolls site and vicinity with radioactivity is reported. Radiation monitoring results are summarized as to magnitude, extent, and frequency of contamination, characterized as to origin, and as-

sessed as to relative health hazard. The period of January 1951 through September 1953 is covered in this survey. Knolls site radioactive waste treatment is discussed, and the Health physics environmental monitoring program is described. Both local and outside influences increase the natural radioactivity content of the atmosphere, of vegetation, and in the Mohawk River; however, the frequency, magnitude, and extent of contamination with radioactive materials vary. Neither local nor outside influences reached proportions to justify concern as to the health hazard aspect of the radioactive contamination. (auth)

11727 LAMS-516

[Los Alamos Scientific Lab., N. Mex.].
SURVEY OF LOS ALAMOS AND PUEBLO CANYON FOR RADIOACTIVE CONTAMINATION AND RADIOASSAY TESTS RUN ON SEWER-WATER SAMPLES AND WATER AND SOIL SAMPLES TAKEN FROM LOS ALAMOS AND PUEBLO CANYONS. William H. Kingsley, Alvin Fox, and J. F. Tribby. Feb. 20, 1947. 47p. Contract [W-7405-eng-36]. \$10.80(ph), \$3.00(mf) OTS.

Chemical sewers and sanitary lines draining the Tech Area, D. P. Site, CMR-12 Laundry, and surrounding residential areas flow into Pueblo and Los Alamos Canyon streams. In order to determine the extent and sources of radioactive contamination in these localities, fluid samples from each of the sewers, soil samples from each of the sewers, soil samples from the ground surrounding the sewer exits, and water and soil samples from selected spots in or near each of the two canyon streams were collected and analyzed for polonium and plutonium. (W.D.M.)

11728 LAMS-2020

Los Alamos Scientific Lab., N. Mex.
THE WIND VARIABILITY OF FALL-OUT PATTERNS. Leon Sherman. Mar. 1956. 24p. \$4.80(ph), \$2.70(mf) OTS.

On the basis of winds from four Pacific shot days, that part of the variability of the computed fall-out intensity patterns due to the variability of the winds was investigated. An extreme case from Operation Sandstone was considered. Tentative operational conclusions are drawn. A map with respect to the expected hotline is presented, giving a best estimate of the 3-hr variability due to winds in fall-out intensity. (W.D.M.)

11729 LAMS-2038

Los Alamos Scientific Lab., N. Mex.
A SURVEY OF SOME LOS ALAMOS COUNTY CANYONS FOR RADIOACTIVE CONTAMINATION, SPRING, 1953 TO SPRING, 1955. Aubrey O. Dodd. Apr. 1956. 17p. Contract W-7405-eng-36. \$3.30(ph), \$2.40(mf) OTS.
A survey analysis is presented of soil samples from Los Alamos, Pueblo, Bayo, and Mortandad canyons to determine the presence and activities of radioactive contaminants. Also included are the results of analyses of a few samples of grass and of surface water. This survey covers the period from spring 1953 to spring 1955. (auth)

11730 LS-25

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON ALPHA-HEALTH PHYSICS: 1. MONITORING FOR ALPHA EMITTERS. 2. MEDICAL EXAMINATION OF WORKERS WITH ALPHA EMITTERS. 3. ANALYSES OF URINE AND BLOOD FOR ALPHA EMITTERS. 4. DRY BOX PROBLEMS. Dec. 1958. 20p.

A bibliography with 138 references is presented. The

source of the search was Nuclear Science Abstracts. (T.R.H.)

11731 M-7008

New York Operations Office. Health and Safety Div., AEC.

DUST AND PRECIPITATION SAMPLING PROGRAM, APRIL THRU JUNE 1951. 31p. \$6.30(ph), \$3.00(mf) OTS.

An attempt to measure dust and precipitation activity from the Greenhouse Operation is described. Results from a sampling network designed to measure fall-out in the Northeastern United States are presented. (W.D.M.)

11732 M-7085(Del.)

Atomic Energy Commission, Washington, D. C. PROGRAMMATIC INVESTIGATIONS, FALL-OUT MATERIALS: THEIR CHEMICAL AND PHYSICAL PROPERTIES AND UTILIZATION BY PLANTS. APPENDIX C. [nd]. Decl. with deletions Apr. 22, 1959. 10p. \$3.30(ph), \$2.40(mf) OTS.

Fall-out materials from the Jangle underground and surface explosions in November 1951 were collected at distances ranging from one-half to eight miles from the explosion sites. The amounts of fall-out ranged up to nearly two tons per acre one-half mile from the underground explosion site. Radioactivity at this point one year after the explosion was nearly one curie per acre. The radioactivity is from fission products carried on glassy material formed by fusion of earth in the explosion. Sr^{90} is taken up by crops grown on soils to which additions of fall-out material had been made. The uptake of strontium depends on the calcium content of the soil. (auth)

11733 M-7097

Los Alamos Scientific Lab., N. Mex.

FALLOUT MEASUREMENT, JANUARY 1 TO NOVEMBER 15, 1958. 21p. Contract [W-7405-eng-36]. \$4.80(ph), \$2.70(mf) OTS.

Fall-out measurements at Los Alamos consisting of gamma background measurements and determination of airborne beta activity are reported for the period Jan. - Nov. 1958. Air sampling and rain collecting apparatus is described. (W.D.M.)

11734 NRL-Memo-626

Naval Research Lab., Washington, D. C.

RADIOACTIVITY OF AIR AND FALLOUT SAMPLES COLLECTED ON THE 80TH MERIDIAN. I. H. Blifford, Jr. and L. B. Lockhart, Jr. Aug. 1956. 13p.

A brief review is given of the status of the project for collecting atmospheric radioactivity samples at various sites along the 80th meridian. Radioactivity data for the months of May and June 1956 are presented. (auth)

11735 NYO-4522(Del.)

New York Operations Office. Health and Safety Div., AEC.

RADIOACTIVE DEBRIS FROM OPERATION IVY. Apr. 28, 1953. Decl. with deletions Apr. 24, 1959. 35p. \$6.30(ph), \$3.00(mf) OTS.

During the Fall 1952 atomic weapons tests (Operation IVY) data for evaluating the effects of radioactive debris on health and sensitive industry were obtained by radiological counting of daily settled dust samples from a worldwide network of 107 stations and by radiation measurements with specially designed instruments in flights over the north Pacific islands. The maximum aerial reading, equivalent to 1.5 mr/hr three feet above ground

and to a cumulative dose of 500 milliroentgens, was obtained over Agrihan in the Marianas, on the third day after MIKE shot. The highest 24 hour fall-out was 3,600,000 d/m/sq ft at Iwo Jima on M + 4. Cumulative fall-out, extrapolated to January 1, 1953, is shown on maps for the first and second 15-day periods after MIKE and for the next 31 days. Dispersion of the radioactive cloud throughout the world atmosphere appears to have been essentially completed during the second two weeks. Cumulative fall-out to January 1, 1953, exceeded 10,000 d/m/sq ft at five locations and was in the hundreds or low thousands at nearly every remaining station. Concentrations of radioactive dust, measured in air samples from 18 stations, were insignificant compared with similar data from previous surveys. Decay rates were approximately proportional to the 1.4 power of the age of the activity, instead of the 1.2 power found during earlier series. (auth)

11736 NYO-4528(Del.)

New York Operations Office. Health and Safety Div., AEC.

PRELIMINARY STUDY OF Sr^{90} DISTRIBUTION AND UPTAKE FOLLOWING NUCLEAR DETONATIONS. Aug. 14, 1953. Decl. with deletions Apr. 28, 1959. 24p. \$4.80(ph), \$2.70(mf) OTS.

Samples of animal bone, soil, vegetation, and settled and airborne dust were analyzed for radioactive strontium. Because of the age of the majority of the material, Sr^{90} rather than Sr^{90} was the isotope found. The results showed widespread low-level activity and appreciable plant and animal uptake. Analyses of human bone for normal strontium content showed values in the range of 0.02% on the basis of bone ash. A critical evaluation of analytical methods for strontium showed that good recoveries were possible from bone ash, soil, and vegetation. The analysis of fall-out samples is not yet satisfactory, but the cause of the difficulty is known and can be eliminated. Determinations of Sr^{90} on human bone samples from victims of the Nagasaki burst were made. Sr^{90} was found, and the results are appended to this report. (auth)

11737 NYO-4571(Del.)

New York Operations Office. Health and Safety Lab., AEC.

PROJECT SUNSHINE PROGRESS FROM SEPTEMBER 1953 TO JANUARY 4, 1954. Jan. 8, 1954. Decl. with deletions Apr. 22, 1959. 90p. \$13.80(ph), \$4.80(mf) OTS.

The results to Jan. 1954 of various investigations on Project Sunshine are summarized. It is pointed out that the data are as yet relatively few and the conclusions drawn must therefore be regarded as tentative, more so in some areas of the report than in others. The most significant findings are listed as the dependence of strontium uptake on soil calcium, the uniformity in the strontium activity in biological materials, the inability to account for the bulk of the debris from Ivy, and the absence of gross fractionation of either Sr^{90} or Sr^{90} in samples analyzed. (W.D.M.)

11738 NYO-4620

New York Operations Office. Health and Safety Lab., AEC.

INTERIM SUNSHINE REPORT. Merrill Eisenbud, John H. Harley, Ira B. Whitney, George A. Welford, James Fresco, Edward P. Hardy, and Robert S. Morse. Jan. 17, 1955. Decl. Apr. 22, 1959. 38p. \$6.30(ph), \$3.00(mf) OTS.

Sunshine data available up to Jan. 1955 are presented without conclusions because of the incomplete nature of the data. Projects reported on include world-wide Sr^{90} fall-out, monitoring of New York City milk, fetal bone, and water supply, contamination at selected pasture sites, sampling of upper air, soil sample analysis from Nevada Test Site, and agreement on Sr^{90} analysis. (W.D.M.)

11739 NYO-4623(Del.)

New York Operations Office. Health and Safety Lab., AEC.

RADIOACTIVE DEBRIS FROM OPERATION CASTLE ISLANDS OF THE MID-PACIFIC. Alfred J. Breslin and Melvin E. Cassidy. Jan. 18, 1955. Decl. with deletions Apr. 22, 1959. 75p. \$15.30(ph), \$5.40(mf) OTS.

An off-site monitoring program was conducted in the Central and Southwest Pacific to document and to provide current measurements of the radioactive fall-out during Operation Castile. The combination of fixed continuous monitoring stations and aerial surveys provided rapid accurate information about radioactive fall-out. The Scantameter, a sensitive wide-range scintillation-type meter, was demonstrated to be a dependable, portable, facile instrument for aerial monitoring use. Data observed from the monitoring program are presented graphically and in tabular form. (C.H.)

11740 NYO-4643

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT FOR JANUARY AND FEBRUARY. Apr. 21, 1955. Decl. Apr. 22, 1959. 24p. \$4.80(ph), \$2.70(mf) OTS.

Sr^{90} fall-out for the months of December and January at the ten eastern stations measured varied from 0.0 to 13 d/m/ft²/month. The comparison of gummed paper and a high-walled stainless steel pot agreed during the month of January. February showed a sharp rise in total activity and Sr^{90} content of gummed paper and pot. The Sr^{90} content of wet and dry milk remained constantly around 1.0 Sunshine Unit during December and January. The Sr^{90} values were also low. Tap water collected during December and January range from 0.094 to 0.2 Sr^{90} d/m/liter. Sr^{90} showed a rise in the early March period. (auth)

11741 NYO-4646

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT FOR MARCH AND APRIL. May 20, 1955. Decl. Apr. 22, 1959. 23p. \$4.80(ph), \$2.70(mf) OTS.

The fall-out of Sr^{90} during the month of September averaged 3.1 d/m/ft². The southeastern United States showed no measurable fall-out during the month of September. The comparison of gummed paper and a high-walled stainless steel pot showed comparative Sr^{90} to total activity ratios for February and March. The Sr^{90} content of wet and dry milk remained at approximately 1.0 Sunshine Units during February. The Sr^{90} content of tap water at HASL reached 0.4 ± 0.06 d/m/liter during early April. The Japanese bones showed traces of activity in eleven of the twenty-two bone samples analyzed. (auth)

11742 NYO-4653

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT FOR MAY AND JUNE. July 5, 1955. Decl. Apr. 22, 1959. 40p. \$6.30(ph), \$3.00(mf) OTS.

The fall-out of Sr^{90} at the 38 stations measured in 1954 in the United States showed the following averages: September, 3.77 d/m/ft²; October, 3.29 d/m/ft²; and November, 3.96 d/m/ft². The fall-out at the 12 stations measured in South America showed the following averages: September, 8.68 d/m/ft²; October, 6.72 d/m/ft²; and November, 9.88 d/m/ft². The comparison of gummed paper and a high-walled stainless steel pot showed variation during the month of April. The Sr^{90} collected on gummed paper is a factor of two lower than the Sr^{90} collected in the steel pot for the month of April. The first monthly composite of milk samples from the metropolitan area for the month of April showed approximately one Sunshine Unit. This agreed favorably with the individual weekly determinations. Japanese dry whole milk powder showed a Sr^{90} content between 1 to 3 d/m/qt during November, December, and January. Soil samples from the Nevada test site area show appreciable Sr^{90} content. (auth)

11743 NYO-4661

New York Operations Office. Health and Safety Lab., AEC.

SUNSHINE REPORT FOR JULY AND AUGUST. James M. Fresco, Seymour Licht, and George A. Welford, comps. Sept. 16, 1955. Decl. Apr. 22, 1959. 58p. \$9.30(ph). \$3.60(mf) OTS.

The estimated average fall-out of Sr^{90} in the U. S. during Dec. 1954 was 3.59 d/m/ft². Estimated world total fall-out and Sr^{90} fall-out levels are given. Collection efficiencies of gummed paper and a high-walled stainless steel pot are compared. Strontium levels in milk from New York City, Madison, Wisc., and Mandan, N. D., rain water collected at Watertown, N. Y., and Japanese bone are given. (W.D.M.)

11744 SC-4152(TR)

[Sandia Corp., Albuquerque, N. Mex.]

CLIMATOLOGICAL EFFECT SCALING WINDS FOR THE UNITED STATES. B. N. Charles. Feb. 1958. Decl. Feb. 12, 1959. 53p. \$9.30(ph), \$3.60(mf) OTS.

A single-wind fall-out model, often referred to as the "AFSWP method," is frequently used to calculate the geographical distributions of the radiological dosages from fall-out following nuclear detonations. The single wind used is termed the "effect scaling wind." Mean effect scaling winds and their statistical variabilities are presented for the North American continent for seasonal periods and the weapon yields 0.1, 1.0, 10.0, and 50.0 megatons. The results are presented as isograms on maps. The basic wind data used are from a recent compilation which is believed to be vastly superior to any previously available climatological wind data. These results are suitable for use in Monte Carlo methods for computing the probabilities of occurrence of various radiological dosages. They may also be used for simple hand-computed estimates of target environs that are subject to various probabilities of experiencing specified radiological dosages after nuclear attacks. (auth)

11745 TID-5489

Weather Bureau, Washington, D. C.

A METHOD OF FALLOUT PREDICTION FOR TOWER BURSTS AT THE NEVADA TEST SITE. Kenneth M. Nagler, Lester Machta, and Francis Pooler, Jr. June 1955. Decl. Apr. 22, 1959. 51p. \$10.80(ph), \$3.90(mf) OTS.

A method is presented for predicting fall-out for tower bursts at the Nevada Test Site. The computation is based

on maximum energy yield of the device, tower height, cloud height, winds for 5 basic layers and the distance to be travelled in each of the five layers by a falling particle of 120-micron diameter and specific gravity of 2.5. A basic model is presented which is based on data accumulated during the Snapper-Tumbler and Upshot-Knothole test series. (C.H.)

11746 UCLA-108

California. Univ., Los Angeles. Atomic Energy Project.

ALPHA ACTIVITY DUE TO THE 1945 ATOMIC BOMB DETONATION AT TRINITY, ALAMOGORDO, NEW MEXICO. Interim Report. K. H. Larson, J. L. Leitch, W. F. Dunn, J. W. Neel, J. H. Olafson, E. E. Held, J. Taylor, W. J. Cross, A. W. Bellamy, and L. Baurmash. Jan. 5, 1951. Decl. Dec. 16, 1958. 44p. \$7.80(ph), \$3.30(mf) OTS.

Plutonium was found in soil, plants, and rodents collected from various locations along the line of fall-out for at least a distance of 85 miles from the fenced area with a maximum being found at 28 miles from ground zero on the Chupadera Mesa. Alpha activity was found in bone, liver, muscle, and connective tissue of rodents collected 28 miles from the crater. Alpha activity in air-borne material was determined. (W.D.M.)

11747 UCLA-182

California. Univ., Los Angeles. Atomic Energy Project.

FIELD OBSERVATIONS AND PRELIMINARY FIELD DATA OBTAINED BY THE U.C.L.A. SURVEY GROUP ON OPERATION JANGLE, NOVEMBER 1951. K. H. Larson, J. H. Olafson, H. M. Mork, and D. R. Howton. Jan. 29, 1952. Decl. Apr. 22, 1959. 28p. \$6.30(ph), \$3.00(mf) OTS.

Observations on each of the Jangle Operation detonations and preliminary data on the area contaminated by the fall-out material are summarized. Estimated fall-out patterns are suggested for each detonation based on counting at various sites. The first crop of radishes grown on contaminated soil absorbed a significant percentage of radioactivity. (W.D.M.)

11748 UCLA-243

California. Univ., Los Angeles. Atomic Energy Project; Rochester, N. Y. Univ. Atomic Energy Project; and Washington. Univ., Seattle.

PRELIMINARY STUDY OF OFF-SITE AIR-BORNE RADIOACTIVE MATERIALS, NEVADA PROVING GROUNDS. I. FALL-OUT ORIGINATING FROM SNAPPER 6, 7, AND 8 AT DISTANCES OF TEN TO FIFTY MILES FROM GROUND ZERO. Jon H. Olafson, James W. Neel, Charles J. Spiegl, Robert H. Wilson, Frank G. Lowmen, and Kermit H. Larson. Feb. 16, 1953. Decl. Apr. 22, 1959. 123p., 3 illus. Contract AT-04-1-GEN-12. \$28.80(ph), \$8.40(mf) OTS.

The operations of the intermediate zone fall-out program (10 to 50 miles) conducted in connection with Operation Snapper 6, 7, and 8 during May and June 1952 are reviewed. The maximum concentrations of air-borne fission products in this area as determined by means of Hi-Volume samplers were 1.0 to 2.7 $\mu\text{C}/\text{m}^3$. Particle size distribution of the air-borne material was determined by modified Casella Cascade impactors. Fall-out patterns were determined by gummed papers. Decay data are presented on a number of selected typical samples from each detonation. (W.D.M.)

11749 UCLA-362

California. Univ., Los Angeles. Atomic Energy Project.

QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1956. Stafford L. Warren. Apr. 1, 1956. Decl. Apr. 22, 1959. 132p. Contract AT-04-1-GEN-12. \$19.80(ph), \$6.30(mf) OTS.

Progress is reported in the following studies: the synthesis of labeled fatty acids; the pharmacological properties of a series of oxazolium compounds in mice; the effects of atropine on the response of rat uterus to 5-hydroxytryptamine and acetylcholine; the effect of quinoxaline 1:4 di-n-oxide on survival time of irradiated mice; the effect of acute and chronic intravenous infusions of clinical dextran in irradiated rabbits; the effect of particle size on pulmonary absorption and distribution; the development of kidney function tests employing radioactive Diodrast and external gamma ray scintillation counting techniques; blood radioactivity measurements; the mechanism of the skeletal deposition of Ca^{45} and Sr^{90} ; the production, extraction, and purification of an antibiotic substance produced by an intestinal lactobacillus; the late effects of total-body x irradiation on rats exposed under 5% hypoxia; radio-induced lesions in the eye of the newly metamorphosed toad; routine monitoring and health physics procedures; the development of procedures for the spectrographic analysis of bone ash; design of a freeze-dryer for the preparation of tissue specimens for electron microscopy; the production and calibration of chemical systems of radiation measurement having medical applications; the physiological effects of air blast in mice; tracer studies on the plant uptake of Sr and Cs from various soil types; tracer studies on the effect of Ca on the uptake of Sr by plants and the uptake of Sr from plant material ingested by animals; and the biological accumulation and persistence of fission products from radioactive fall-out. (For preceding period see UCLA-357.) (C.H.)

11750 UCRL-8412

California. Univ., Berkeley. Radiation Lab. BIBLIOGRAPHY OF TECHNICAL REPORTS ON THE EFFECTS OF FALLOUT. Roger Wallace. July 1958. 70p. Contract W-7405-eng-48. \$2.00(OTS).

A bibliography on the effects of fall-out is presented. It was compiled from the report literature published prior to July 1958. A list of bibliographies of published work on radiation effects is also included. 447 references. (J.R.D.)

11751 UWFL-7

Washington. Univ., Seattle. Applied Fisheries Lab. RADIOBIOLOGICAL RESURVEY OF BIKINI ATOLL DURING THE SUMMER OF 1947. 1947. Decl. Feb. 16, 1956. 62p. \$10.80(ph), \$3.90(mf) OTS.

The 1947 studies were designed to determine the presence or absence of radiation in the various marine organisms, the distribution of radioactive substance in the plants and animals from different geographical locations, and the amounts of radioactive substances in certain tissues and organs. Most of the organisms studied were fish or marine invertebrates. Some pertinent radioautographs are presented. (W.D.M.)

11752 UWFL-40

Washington. Univ., Seattle. Applied Fisheries Lab. RADIATION LEVELS IN BIOLOGICAL SAMPLES COLLECTED AT PONAPE, CAROLINE ISLANDS, DECEMBER 16-17, 1954. Lauren R. Donaldson, Edward E. Held, and Paul R. Olson. Mar. 10, 1955. 8p. Contract AT(45-1)-540. \$1.80(ph), \$1.80(mf) OTS.

The results of a radiological survey of foods of the

people of Micronesia are presented. Samples of plankton, fish, and marine and land plants were collected at Ponape, Caroline Islands, Dec. 16-17, 1954. (W.D.M.)

11753 WT-425(Del.)

Los Alamos Scientific Lab., N. Mex.
RADIOLOGICAL SAFETY; OPERATION BUSTER-JANGLE. Thomas L. Shipman. July 1953. Decl. with deletions Apr. 24, 1955. 60p. \$10.80(ph), \$3.90(mf) OTS.

A description of the responsibilities, organization, and activities of the Radiological Safety and Health Unit for Operation Buster-Jangle is given. Suggestions as to changes which should improve the operation of, and the service rendered to, the Test Director by such a unit are also included. Data on radiation exposures of operation personnel, decontamination, residual radiation levels of shot sites, and residual off-site fall-out intensities are included in appendixes. (auth)

11754 WT-552

Los Alamos Scientific Lab., N. Mex.
ACTIVITIES OF THE SPECIAL WEATHER ADVISORY SERVICE. OPERATION TUMBLER-SNAPPER. Clifford A. Spohn. Nov. 1952. Decl. Apr. 22, 1959. 59p. \$9.30(ph), \$3.60(mf) OTS.

Certain weather advisory functions were delegated to the Group H-6 (LASL) Weather Section during test activities at the Nevada Proving Grounds. The techniques utilized in performing these functions are outlined, and the actual advisories, forecasts, and analyses issued are made a matter of record. There is some discussion as to the consistency of certain phases of the advisory services and indications of future study and amplifications of the results. (auth)

11755 WT-566

Los Alamos Scientific Lab., N. Mex.
REPORT OF THE ADVISORY PERSONNEL TO THE AIR-SAMPLING PROGRAM. OPERATION TUMBLER-SNAPPER. William S. Johnson, Edwin C. Hyatt, and Harry F. Schulte. June 1953. Decl. Apr. 22, 1959. 120p. \$18.30(ph), \$6.00(mf) OTS.

The Industrial Hygiene Group of LASL was called upon to act in an advisory capacity for the air sampling program for Tumbler-Snapper Operation. The results of the program as well as an evaluation of the administrative, personnel, and equipment requirements necessary to provide these results on subsequent tests are presented. The air sampling program encompassed the area outside the Proving Grounds and extending approximately 200 miles. Equipment used was essentially that inherited from Operation Buster-Jangle. Results from the various monitoring locations are given along with significant radioautographs. (W.D.M.)

11756 WT-616

Washington, Univ., Seattle. Applied Fisheries Lab.
RADIOBIOLOGICAL STUDIES AT ENIWETOK BEFORE AND AFTER MIKE SHOT. Lauren R. Donaldson. June 1953. Decl. Apr. 22, 1959. 98p. Project 11.5 [of] OPERATION IVY. \$15.30(ph) \$5.40(mf) OTS.

Results of measurements are reported of the residual radiation found in the living organisms of Eniwetok Atoll as a result of previous weapons tests in this area and a resurvey, following Mike shot, to determine the change in amounts, kinds, and distribution of radioactive materials. Specimens collected from Oct. 20 to Nov. 11, 1952, included plankton, algae, rats, birds, fish, plants, and invertebrate organisms. (W.D.M.)

11757 WT-811

California. Univ., Los Angeles. Atomic Energy Project.

DISTRIBUTION AND CHARACTERISTICS OF FALL-OUT AT DISTANCES GREATER THAN 10 MILES FROM GROUND ZERO, MARCH AND APRIL 1953. Charles T. Rainey, James W. Neel, Harold M. Mork, and Kermit H. Larson. Feb. 1954. Decl. Apr. 22, 1959. 92p. Project 27.1 [of] OPERATION UPSHOT-KNOTHOLE. \$15.30(ph), \$5.40(mf) OTS.

Detailed studies of the physical phenomenon of fall-out were performed to provide information basic to the proper evaluation of the possible hazards associated with fall-out. The project functioned during shots 2, 3, 4, 5, and 7 of Operation Upshot-Knothole. Samples and measurements were taken along existing trails and roads which crossed the various fall-out patterns at distances greater than 10 miles from ground zero. (W.D.M.)

11758 WT-812

California. Univ., Los Angeles. Atomic Energy Project.

ENVIRONMENTAL AND BIOLOGICAL FATE OF FALL-OUT FROM NUCLEAR DETONATIONS IN AREAS ADJACENT TO THE NEVADA PROVING GROUNDS. Robert G. Lindberg, James T. Scanlan, James C. Watson, William A. Rhoads, and Kermit H. Larson. Feb. 1954. Decl. Apr. 22, 1959. 49p. Project 27.2 [of] OPERATION UPSHOT-KNOTHOLE. \$7.80(ph), \$3.30(mf) OTS.

A radio-ecological survey of the area adjacent to the Nevada Proving Grounds in progress intermittently from Sept. 1951 to July 1953 is summarized. Samples have been taken periodically of soils, plants, and animals before, during, and after various test series at distances up to 30 miles from ground zero. Conclusions are drawn on the fission product burden in animal tissue. (W.D.M.)

11759 WT-814

Rochester, N. Y. Univ. Atomic Energy Project.
EFFECTIVE ENERGY OF RESIDUAL GAMMA RADIATION. Adrian H. Dahl, et al. Jan. 1954. Decl. Apr. 22, 1959. 72p. Project 29.4 [of] OPERATION UPSHOT-KNOTHOLE. \$10.80(ph), \$3.90(mf) OTS.

Evaluation of the gamma-ray quality of the residual radiation following an instantaneous fission reaction is necessary for establishing design requirements of radiation-detection instruments used in personnel monitoring. A theoretical study of the gamma-ray spectrum from fission products is described as a function of time from the fission reaction. The energy flux of photons with energy below 0.2 Mev increases relative to that of photons with higher energies as the time from fission reaction increases relative to that of photons with higher energies as the time from fission reaction increases up to seven days. This increased relative flux of photons with energies below 0.2 Mev, together with a slight general decrease of photon energies due to Compton scattering in the air, can account for the relative variation of readings from energy-dependent detectors which were used in the field studies. Field measurements were obtained with energy-dependent ionization chambers, depth-dose curves in a phantom man, and photographic absorption curves made with copper spheres. These field measurements showed the presence of a wide range of photon energies from around 60 kev to above 600 kev. Unit-density absorbers

were found to be unreliable as effective-energy²-measuring devices in the field studies. Field-equivalent x-ray beam mixtures were determined in the laboratory from the field data employing commonly used x-ray beams. These indicated that the low-photon-energy response of personnel-radiation-monitoring instruments should be checked in an x-ray beam mixture equivalent to 30 roentgen parts of 200-kvp x rays with no filter and 70 roentgen parts of 1000-kvp x rays should be used for the high-photon-energy response. High-energy beta particles were found to produce readings on gamma-ray-measuring instruments in fall-out areas. A beta-particle shield equivalent to approximately 750 mg/cm² of plastic should be placed around the detector component of instruments designed to detect gamma radiation only. (auth)

11760 WT-1178

California. Univ., Los Angeles. Atomic Energy Project.

DISTRIBUTION AND CHARACTERIZATION OF FALL-OUT AND AIRBORNE ACTIVITY FROM 10 TO 160 MILES FROM GROUND ZERO, SPRING 1955.

L. Baurmash, J. W. Neel, W. K. Vance, III, H. M. Mork, and K. H. Larson. Sept. 1958. Decl. Apr. 22, 1959. 122p. \$18.30(ph), \$6.00(mf) OTS.

Fall-out patterns of four tower shots were delineated by survey-instrument methods to distances of approximately 160 miles from Ground Zero. Surface-contamination levels in terms of $\mu\text{c}/\text{ft}^2$ and fall-out particle-size distributions were determined by soil-sample analyses. Airborne radioactivity concentrations determined by air samplers of different types and supports agreed within a factor of 4; aerosol radioactivity median diameters of $< 5 \mu$ were determined by cascade impactors. The solubilities of fall-out and airborne radioactivity in 0.1N HCl ranged from 20 to 30 and 65 to 85 per cent, respectively. More than 90 per cent of the fall-out from two shots was magnetic. Beta-decay slopes ranged from $T^{-0.80}$ to $T^{-1.30}$, and field gamma-decay slopes ranged from $T^{-1.07}$ to $T^{-2.10}$. Principal beta-energy peaks of 0.6 and 2.0 Mev were observed. (auth)

11761 WT-1496

Food and Drug Administration, Washington, D. C. and Federal Civil Defense Administration, Washington, D. C.

EFFECT OF FALLOUT CONTAMINATION ON PROCESSED FOODS, CONTAINERS, AND PACKAGING.

Harold V. Leininger, Edwin P. Laug, Homer J. McConnell, Raymond D. Chapman, Stephen E. Koelz, and Alan T. Spiher. Mar. 1958. 17p. Project 39.1-I [of] OPERATION PLUMBBOB. \$0.75(OTS).

The effect of a comparatively low level of fallout on the protective qualities of 18 packaging materials was examined. It was found that the plastics and paper tested were adequate for preventing contamination of foods packaged therein; by contrast, burlap and cloth offered poor protection. Oily or dusty surfaces proved more retentive for fallout than clean ones. Of the cleaning measures tried, wet or dry cloth wiping seemed to be the most effective, with detergent washing and brushing next in order. Many retail packages, particularly those with a waxed-paper overwrap, retained considerable amounts of fallout. There were, however, only two cases in which contamination of the contents of retail packages could be demonstrated. (auth)

11762

DOSIMETRY OF X-RAYS AND GAMMA RAYS BY THE

PHOTOGRAPHIC METHOD. F. Behounek, J. Klumpar, J. Koci, and P. Jirousek. Czechoslov. J. Phys. 7, 565-81(1957). (Translated from *Referat. Zhur. Fiz.* No. 8, 1958, Abstract No. 17390.)

The properties of Czechoslovak photographic materials are examined along with the possibility of their use for photographic dosimetry.

11763

ACCIDENTAL RADIATION EXCURSION AT THE OAK RIDGE Y-12 PLANT. I. DESCRIPTION AND PHYSICS OF THE ACCIDENT. Dixon Callihan and Joseph T. Thomas (Oak Ridge National Lab., Tenn.). *Health Phys.* 1, 363-72(1959) Mar.

An aqueous solution of enriched uranium inadvertently flowed into a 55 gal drum in a process area in Oak Ridge in June 1958, establishing a prompt-critical neutron chain reaction in which about 10^{18} fissions occurred before the system finally became subcritical by the addition of water. The solution contained about 2.5 kg of U^{235} . Records of the radiation field show the power excursion to have continued about 20 min during which the reaction oscillated a number of times. This paper describes the accident and presents a reactor-physics analysis yielding reactivities in an unperturbed system as great as 1.3 per cent which were above zero for a time consistent with observations. A plausible sequence of events during the excursion is enumerated. The emergency and health physics procedures and the medical observations of exposed personnel will be given in subsequent papers of this series. (auth)

11764

PENETRATION OF WEAPONS RADIATION: APPLICATION TO THE HIROSHIMA-NAGASAKI STUDIES. R. H. Ritchie and G. S. Hurst (Oak Ridge National Lab., Tenn.). *Health Phys.* 1, 390-404(1959) Mar.

Basic data necessary for the consideration of shielding against nuclear weapons radiation are presented. These include the variation of dose with distance from nuclear detonations, angular distribution of neutrons and γ -radiation, and some information on the spectrum of fast neutrons. Application of the data is made to the problem of determining the radiation dose in light frame structures. Experimental attenuation factors for typical Japanese houses are given. (auth)

11765

REPORT TO THE SURGEON GENERAL, U. S. PUBLIC HEALTH SERVICE ON THE CONTROL OF RADIATION HAZARDS IN THE UNITED STATES. The National Advisory Committee on Radiation, 1959. 22p.

The conclusions reached by the National Advisory Committee on Radiation of the Surgeon General's Office, U. S. Public Health Service, are presented. The trends in dose received by the population, potential increase in dose received, and the downward trend of maximum permissible limits are cited and a radiation control program outlined. State versus Federal regulation is discussed. The need for individuals trained in radiation control methods is pointed out. Specific recommendations made are: primary responsibility for radiation control should be vested in a single federal agency; the agency should be authorized to do broad planning and develop a comprehensive program for all radiation sources. (T.R.H.)

11766

REPORT OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS (ICRU),

1956. National Bureau of Standards Handbook 62. Washington, National Bureau of Standards, 1957. 51p. \$0.40(GPO)

The recommendations of the International Commission on Radiological Units and Measurements of the International Congress of Radiology are given from the meeting in Geneva, April 1956. The operation of the ICRU is described, and quantities, units, and symbols are defined. Guidance for clinical application is offered with respect to specification of radiation treatment and absorbed dose considerations. The physical aspects of absorbed dose determination are treated. The reports of the subcommittees on x-ray standards and standards of radioactivity are presented, and appendixes on a treatment summary form, a survey of primary x-ray standards, and availability of radioactivity standards in the U. S. and U. K. are included. (T.R.H.)

11767

PROTECTION AGAINST NEUTRON RADIATION UP TO 30 MILLION ELECTRON VOLTS. Washington, National Bureau of Standards, 1957. 92p. \$0.40(GPO)

Terms are defined and physical and biological information on neutrons, absorbed dose, dose units, biological effects, permissible dose, gamma and x-ray hazards of neutron sources, and neutron detection and measurement is reviewed. The types of neutron sources in use are described, and their hazards and protection against them are discussed. Some rules for protection against neutron radiation are given and elaborated. (T.R.H.)

11768

THE CONTROL OF RADIATION HAZARDS IN INDUSTRY, 1957. New York State Department of Labor, 1957. 127p.

A compilation is given of the material presented at the first state Radiological Health Conference in Buffalo, Jan. 1956. The chapters are entitled: Fundamentals of Radiation Science; Biological Effects of Ionizing Radiation; Radiation in Industry; Principles of Radiation Hazard Control; Instruments for Detection and Measurement of Radiation; Specific Installations and Operations; Surveying Methods and Procedures; and Regulation of Radiation Hazards in New York State. (T.R.H.)

11769

BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY. NUMBER 14 FOR JULY-SEPTEMBER, 1958. Tokyo, The Japan Meteorological Agency, 1959. 79p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water and atmospheric dusts collected at stations located throughout Japan from July through September 1958. (C.H.)

11770

AIR POLLUTION MEASUREMENTS OF THE NATIONAL AIR SAMPLING NETWORK. ANALYSIS OF SUSPENDED PARTICULATE SAMPLES COLLECTED, 1953-1957. Public Health Service Publication No. 637. Cincinnati, Robert A. Taft Sanitary Engineering Center, 1958. 260p. \$2.00(GPO)

A report of the first 5 years' operation of the U. S. Public Health Service's National Air Sampling Network is presented. The data collected are tabulated, but not analyzed. The data are presented in great enough detail to be of use in establishing other sampling stations in the U. S. (T.R.H.)

11771

LIVING WITH RADIATION. 1. FUNDAMENTALS. THE PROBLEMS OF THE NUCLEAR AGE FOR THE LAYMAN. Francis L. Brannigan. Washington, D. C., U. S. Atomic Energy Commission, 1959. 69p. \$0.45 (GPO)

Hazards and precautions to be taken to prevent unnecessary radiation exposure are discussed for the layman. (C.H.)

INSTRUMENTS

11772 AECU-4099

Michigan. Univ., Ann Arbor. HIGH RESOLUTION DETECTION OF RADIATION. Final Report. Henry J. Gomberg, Fearghus O'Foghludgha, Jacob I. Trombka, and Reubena Weyant. Mar. 1959. 47p. Project No. 3. Contract AT(11-1)-70. \$7.80(ph), \$3.30(mf) OTS.

Descriptions are given of new processes which have been used successfully in high spatial resolution detection of radiation. These techniques are believed to provide adequate support for research work in which precise location of radioactive tracers is needed. The results of experiments with new types of films, suitable for high resolution autoradiography, are given. In one group, the basic silver halide system was retained, but incorporated into films in such a way as to maximize resolution. In others, molecular reaction systems were used so as to eliminate the grain structure problem. Illustrative applications of these systems are shown. Some unsuccessful attempts at new film development are also discussed. (D.E.B.)

11773 AERE-EL/M-35

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England. CONTINUOUS FLOW IONIZATION CHAMBER. F. R. Holt. Dec. 1949. 3p.

A spherical ionization chamber used for measuring alpha emission from thoron in a stream of nitrogen is described. (auth)

11774 AERE-GP/R-2442

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. GOLD FILM THERMOMETERS AND THEIR APPLICATION TO THE SHOCK TUBE. N. H. Price. Jan. 1957. 21p.

Gold film resistance thermometers, some hundred of atoms thick, have been used to detect the passage of shocks in a shock tube. The construction, calibration, and mounting of these films is described. Experiments show that the gold films respond to rapid changes of gas temperature of several degrees centigrade and have negligible effect on the gas flow. A sensitive voltage amplifier is described. This enables the gold film to be used in the shock tube under conditions in which the limit of sensitivity is the thermal noise of the gold film itself. A simple theoretical study suggests that the response time of a gold film thermometer could be as low as 10^{-8} seconds. (auth)

11775 AERE-M/M-227

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. THE PREPARATION OF DEBYE-SCHERER X-RAY

POWDER SPECIMENS IN EVACUATED SILICA CAPILLARIES. R. O. A. Hall. Feb. 1959. 5p. \$0.16(BIS).

An apparatus is described for the preparation, from metallic samples, of x-ray powder specimens in evacuated silica capillaries. The apparatus, which was designed for the preparation of powder specimens from plutonium metal, is particularly useful for the preparation of samples from other reactive metals. (auth)

11776 AERE-X/R-2779

King's Coll., Newcastle Upon Tyne, England.

THE THIN FILM RESISTANCE THERMOMETER FOR THE MEASUREMENT OF TRANSIENT TEMPERATURES IN HOT GASES. R. M. Hill. Dec. 1958. 15p.

A resistance thermometer was developed for the measurement of heat transfer and temperature in hot gases. The thermometer has very low thermal capacities which will quickly adapt to the temperature of the surroundings without significant perturbation. The low thermal capacity is attained by the use of a very thin film. The theory for the interface temperature between the gas and the backing is reviewed. Methods used for manufacturing films for measuring interface temperature between the gas and the backing are reviewed. Methods used for manufacturing films for measuring interface temperatures are discussed. (J.E.D.)

11777 AFOSR-TN-59-162

New York Univ., New York. Coll. of Engineering.

EFFECT OF GASEOUS IMPURITIES IN BF_3 PROPORTIONAL COUNTERS. J. Davila-Aponte. Dec. 1958. 57p. Project No. 9751. Contract AF18(600)-1555. (AD-211141).

The effects which SiF_4 , SO_2 , and SF_6 have on the plateau and pulse-size distribution of a proportional counter were investigated. SiF_4 was tested at 30, 45, and 60 cm Hg of BF_3 . Its effect was found to be independent of the counter pressure for the range of values considered. From the variation in the plateau, the attachment probability for SiF_4 was calculated to be $h = 1.458 \times 10^{-5}$ and its cross section for attachment to be $\sigma_a = 5.12 \times 10^{-29} \text{ cm}^2$. The permissible amount of these gases without the counter being affected beyond the limits of tolerance which are set up were found to be 0.04% for SiF_4 , 0.01% for SO_2 , and $2.0 \times 10^{-6}\%$ for SF_6 . (auth)

11778 AFOSR-TN-59-229

Miami. Univ., Carol Gables, Fla.

STUDIES OF IONIZATION PARAMETERS IN NUCLEAR EMULSIONS. M. Blau, S. C. Bloch, C. F. Carter, and A. Perlmutter. Feb. 4, 1959. 32p. Contract AF49(638)-97. (AD-211842).

A semi-automatic instrument for ionization measurements in emulsion is briefly described. The instrument was used in the investigation of the various ionization parameters. Deviations from a purely exponential gap-length distribution were observed. This observation casts some doubt on the unrestricted use of the mean gap length as a parameter. A new parameter, based on the blob length distribution, and which is useful over the entire ionization range, is proposed. The relation of this parameter to grain density is discussed. It is shown that the behavior of the latter (as determined from the blob length distribution) as a function of restricted ionization loss seems to be in agreement with theoretical expectations, with the exception of the very dense region, where appropriate corrections are proposed. (auth)

11779 DP-342

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

A GAMMA MONITOR FOR LIQUID STREAMS.

Edward C. Wingfield. Dec. 1958. 9p. Contract AT(07-2)-1. \$0.50(OTS).

A simple and reliable instrument was developed for indicating the gamma activity from fission products in a liquid stream. The range of the instrument was from zero to 12,500 c/(min)(ml). (auth)

11780 KAPL-2007

Knolls Atomic Power Lab., Schenectady, N. Y.

CALCULATION OF FLUX TO DOSE RATE CONVERSION FACTORS FOR FAST AND INTERMEDIATE ENERGY NEUTRONS. D. W. Johnson and E. J. Romesberg. Mar. 20, 1959. 15p. Contract W-31-109-Eng-52. \$0.75(OTS).

The ideal neutron dosimeter would have a response to neutrons of different energies proportional to the variation of damage to tissue. For such an instrument, the neutron source used for calibration need not have the same spectrum as the flux being measured for dose rate. The conversion factor to be used for a polonium-beryllium source for calibrating such an ideal detector is 0.13 mrem/hr per Po-Be neutron/cm²-sec. An instrument which approaches this ideal is the Hurst detector. However, since this detector does not detect neutrons of energy $\lesssim 0.2$ Mev, the "long counter" (paraffin-wrapped BF_3 detector) is often used for detecting in the intermediate energy range (thermal energy $\lesssim E \lesssim 0.2$ Mev). The problems of reading dose rates with these types of instruments are discussed. (auth)

11781 NP-7379

Battelle Memorial Inst., Columbus, Ohio.

NEUTRON DOSIMETRY RESEARCH. Quarterly Progress Report No. 3 for the Period September 15 to December 14, 1957. W. S. Diethorn, E. Paskell, R. K. Willardson, J. W. Moody, R. Beck, G. LaMale, J. McFarling, D. J. Hamman, P. Schall, and G. D. Calkins. Mar. 24, 1958. 44p. Contract DA-36-039-SC-73174.

The effects of fast neutrons on the minority-carrier lifetime and lifetime-dependent properties of selected semiconductor materials are being investigated. Three methods for measuring lifetimes are discussed. The effects of fast neutrons on the minority-carrier lifetime of p- and n-type bulk silicon, bulk germanium, and germanium and silicon junction devices were determined. The rate of thermal annealing of the radiation-induced changes in lifetime was determined for silicon samples and junction devices. The low sensitivity of compound semiconductors to gamma radiation was verified with an experiment on CdTe. Preparation of InP and GaAs by a two-furnace method is described. An investigation of the effects of short bursts of high-intensity radiation on the performance of electrometer-type ionization chambers for personnel dosimetry is described. Two alternative dosimetry systems were investigated: (1) the increase in resistance of tin oxide films when exposed to γ -radiation; and (2) neutron activation of ionization chamber walls. (For preceding period see NP-6490.) (W.D.M.)

11782 NP-7433

Mine Safety Appliances Co., Callery, Penna.

A1W HYDRODYNAMIC TEST NO. 1 (CA-41); EFFECTS OF INLET GEOMETRY ON FLOW COEFFICIENT OF

INSTRUMENT STUB TUBES. Memo Report 128. M. J. McGoff and C. J. Glaser. July 12, 1957. 16p. Contract NObs-65426.

Seven flow tubes were investigated in the MSA 6 in. aluminum loop. Flow coefficients ranged from 0.60 to 1.40 and the Reynolds numbers ranged from 225,000 to 3,400,000. The flow tubes which were the most insensitive to inlet geometry effects were the Foster Tube; 3.60 in. throat, for short tubes and the Venturi tube; 4.30 in. throat for long tubes. (auth)

11783 ORNL-2686

Oak Ridge National Lab., Tenn.

THERMOCOUPLE DESIGN AND TEST PROGRAM FOR REACTOR PROJECTS. J. T. DeLorenzo. May 6, 1959. 63p. Contract W-7405-eng-26. \$1.75(OTS).

Tests were made to determine the stability of swaged, 0.250 inch OD Inconel-sheathed, Chromel P-Alumel thermocouple material with MgO insulation at 1100 to 1800°F under conditions where the temperatures were static, slowly cycled, and rapidly cycled. All tests were conducted for a minimum of 3000 hours. A reliable method for the fabrication of the closure weld using Heliarc was developed. The effects of bending, welding, and brazing on the sheath were also investigated with a special traveling-gradient furnace. Comparison tests on a substitute thermocouple system employing 0.250 inch OD Inconel tubing as the protection tube were also made. Various types of thermocouple wires including Chromel P-Alumel were investigated. A Chromel P-Alumel system using short wells made from $\frac{1}{4}$ inch and $\frac{3}{8}$ inch schedule 40 Inconel pipe was designed and tested under similar conditions. (auth)

11784 RIB-39

DuMont (Allen B.) Labs., Inc. Tube Operations Div., Passaic, N. J.

DEVELOPMENT OF PHOTOMULTIPLIER TUBES. Supplementary Report. Jenny Bramley. [nd]. 21p. Contract AT(30-1)-1336. \$4.80(ph), \$2.70(mf) OTS.

An iterative technique for determination of electron trajectories is described. The method is applicable to all types of problems of trajectories, especially in the design of particle accelerators. The evaluation of the potential field inside an electrostatic device by means of the relaxation method is a numerical boundary value problem; however, once this problem is solved, the iterative determination of electron trajectories is perfectly general except in the immediate vicinity of the emission point, which may require separate handling because of its geometrical configuration. (J.R.D.)

11785 SCR-70

Sandia Corp., Albuquerque, N. Mex.

VARIABLE INDUCTANCE MODULATION OF A TRANSISTORIZED SUBCARRIER OSCILLATOR. C. E. Land. May 1959. 32p. \$1.00(OTS).

For presentation at National Telemetry Conference, Denver, May 1959.

An analysis of a basic variable inductance modulated oscillator is presented. The transistor oscillator and the modulator are first described separately, followed by an analysis of the combined modulator-oscillator circuit. Particular emphasis is placed upon linear correspondence between oscillator frequency and modulator input stimuli. One method of obtaining this linear operation is described. Other methods requiring further investigation of the magnetic circuit are possible. Temperature stability of the circuit is discussed briefly.

Some particular applications of the circuit are presented to illustrate the inherent advantages of the circuit. (auth)

11786 SCTM-24-59(15)

Sandia Corp., Albuquerque, N. Mex.

THE DEVELOPMENT OF AN ETCHED-CIRCUIT ROTARY STEPPING SWITCH. B. F. Sediack. Mar. 9, 1959. 15p. Contract [AT(29-1)-789]. \$3.30(ph), \$2.40(mf) OTS.

The development of a new etched-circuit rotary stepping switch is described. The switch, capable of either manual or automated operation, is of sealed, modular construction and uses etched-circuit cards for switching decks. The actuator is a solenoid motor which is connected to a spring-loaded stepping mechanism for optimum performance at high-torque, low-temperature conditions. Because of the interchangeability of circuit decks and the modular construction, the switch is more reliable and versatile than commercially available versions. (auth)

11787 SCTM-45-59(14)

Sandia Corp., Albuquerque, N. Mex.

RADIO-FREQUENCY SHIELDING OF CABLES. Charles W. Harrison, Jr. Feb. 28, 1959. 13p. Contract [AT-(29-1)-789]. \$3.30(ph), \$2.40(mf) OTS.

Cable shielding to minimize radiofrequency pickup is discussed briefly in a qualitative way. Guide lines for the design of effective shields for this purpose are set forth. (auth)

11788 SCTM-83-59(14)

Sandia Corp., Albuquerque, N. Mex.

TYPE AND QUANTITY OF DATA AVAILABLE AT SANDIA CORPORATION ON PULSE RADAR RETURN FROM THE GROUND. C. H. Bidwell and C. S. Williams, Jr. Mar. 26, 1959. 3p. Contract [AT(29-1)-789]. \$0.50(OTS).

Studies were made at frequencies of about 400 and 4000 Mcps by use of a low-speed aircraft that made straight and level runs, each of a few seconds duration, over various terrains that may be categorized into about 16 general types. Over each terrain that was chosen for study, runs were made at 2000, 4000, 7000, and 12,000 feet. The antennas had low gain and were directed straight down. The detected envelopes of the individual pulse returns were photographed and were subsequently analyzed to obtain the probability distribution of returns for each run; from these distributions, the median return for each run was read. (The pulse-to-pulse correlation was calculated for some runs.) (auth)

11789 SCTM-101-59(15)

Sandia Corp., Albuquerque, N. Mex.

AUTOMATIC X-Y PLOTTER. Ralph Grill. Apr. 22, 1959. 16p. Contract [AT(29-1)-789]. \$3.30(ph), \$2.40(mf) OTS.

An automatic X-Y plotter is described which plots rectangular coordinate graphs from data on perforated paper tape. The X-Y plotter consists basically of a commercial paper tape reader, a Sandia designed control system, and a commercial Variplotter. The paper tape reader provides digital output; the control system converts digital information into an analog voltage acceptable to the Variplotter; and the Variplotter converts the analog input voltage to graphic representation. A description is given of the paper tape format, the method of address selection and storage, operation of the storage selector and shift register including the digital-to-analog conversion, the logic necessary for

operation with one or two tape readers, and calibration procedure. (auth)

11790 SCTM-436-58(14)

Sandia Corp., Albuquerque, N. Mex.

TRANSMISSION-LINE MISSILE ANTENNAS. Ronold W. P. King, Charles W. Harrison, Jr., and David H. Denton, Jr. Nov. 20, 1958. 23p. Contract [AT(29-1)-789].

Protruding rocket antennas of low silhouette are examined using transmission-line concepts. The theory was developed specifically for nondissipative terminations and line sections; however, the formulas are readily generalized to include ohmic losses in the lines and terminations. Adaptive computations may be made for conductors other than circular and the theory may be used to analyze antennas of other missiles. (J.R.D.)

11791 WADC-TR-56-360

Perkin-Elmer Corp., Norwalk, Conn.

DEVELOPMENT OF AN EXPERIMENTAL GAS RADIATION PYROMETER. [Period covered] July 1, 1955 - June 30, 1956. Report No. 5021. Gordon W. Dueker and Eugene L. Woodcock. July 24, 1956. 61p. Project No. 3073-30245. Contract AF33(600)-30130. (AD-110719; PB-151031). \$1.75(OTS).

Investigation was made of methods of gas radiation pyrometry which are applicable to the measurement of the extreme temperatures of combustion gases in jet engines. Particular consideration was given to development of an instrument which could measure the extreme temperatures and be able to withstand engine skin temperatures of 1000°F. In this regard, materials for the construction of a detector cell including thermopile detector, windows, and lead seals were investigated; selective detectors utilizing the absorption of CO₂ and other types of filters were built and tested; and total radiation type detectors were considered, and the use of thermistors and resistance wire elements as sensors were investigated. (auth)

11792 WAPD-PM-34

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

THE HIGH-TEMPERATURE FISSION COUNTER. S. B. Gunst. Sept. 1955. 34p. Contract AT-11-1-GEN-14. \$6.30(ph), \$3.00(mf) OTS.

When the source-level thermal-neutron flux outside the pressure vessel of a pressurized-water reactor is of the same order of magnitude as the cosmic-ray background, it is not possible to measure the source level by conventional means. Methods for measuring source level are discussed, and it is shown that a fission counter in a re-entrant thimble offers greatest promise at this time. To eliminate the necessity for a special cooling system for the detector, a fission counter was developed which functions equally well at room temperature and at 550°F. This detector is described as are results of tests at the different temperatures. The response to gamma rays is indicated by results obtained during exposure to Van de Graaff x rays. Spherical-electrode geometry is found to be superior to cylindrical-electrode geometry when the gamma background is intense. For reactor application, two improved designs of the high-temperature fission counter are described. (auth)

11793 SCL-T-238

THE AIRCRAFT RADIO DROP-SONDE. (Samoletnyi Sbrasyvaemyi Radiozond.) S. I. Neopomnyashchii (Neopomnyashchii). Translated by Marcel I. Weinreid

(Sandia Corp.) from Nauch.-Issledovatel'. Inst.

Gidromet. Priboroostroen. 5, 17-40(1957). 61p. (Includes original, 24p.). \$9.30(ph), \$3.60(mf) JCL or LC.

An aircraft radiosonde is described which is designed for measuring pressure, temperature, and humidity of the air at varying altitudes up to 15,000 m. This radiosonde consists of a cylindrical casing, a meteorblock, a radiotransmitter, feeder or feeding block, and a parachuting system equipped with a remote control mechanism for opening the chute. The dropping of the radiosonde may be accomplished either manually or automatically using ejection methods from a hermetically closed fuselage. (A.C.)

11794

USE OF SOURCES OF LARGE DIMENSIONS IN β SPECTROMETERS WITH INTEGRAL REGISTRATION. E. Friedlander and E. Ruckenstein. Acad. rep. populare Romine Studii cercetări fiz. 6, No. 2, 113-17 (1957). (Translated from Referat. Zhur. Fiz. No. 6, 1958, Abstract No. 12449.)

The kernels of the integral equations that express the total number of particles recorded by a β spectrometer of the integral type are calculated for the case of a source that covers the entire surface of the cross section of the spectrometer cylinder. (W.D.M.)

11795

MULTI-PLATE IONIZATION CHAMBER FOR THE DETECTION OF SLOW NEUTRONS. Andrzej Bubzanowski and Kazimierz Grotowski Inst. of Nuclear Research, Kharkow). Acta Phys. Polon. 16, 135-8(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19761.)

A description is given of an ionization chamber, the electrodes of which are coated with a layer of natural boron of thickness 3 mg/cm². Each electrode of the chamber consists of three disks, placed between plates of the other electrodes. The capacitance between the electrodes does not exceed 15 micromicrofarads. The technology of coating the layer is as follows: the boron is mixed with alcohol and a small amount of Canada balsam and is coated in the form of an emulsion on the plates. The chamber efficiency is approximately 2%. The filler is argon at atmospheric pressure. The duration of the output pulses after forming is approximately 5 microseconds.

11796

ELECTRONIC CONTROLLED-POTENTIAL COULOMETRIC TITRATOR. M. T. Kelley, H. C. Jones, and D. J. Fisher (Oak Ridge National Lab., Tenn.). Anal. Chem. 31, 488-91(1959) Apr.

A simple electronic instrument for coulometric redox titrations at controlled potential is described. The potential of only the electrode at which the desired reaction occurs is controlled by a stabilized difference amplifier combined with a transistor current amplifier. The electrolysis current is integrated by a stabilized amplifier. The integral is read out as a voltage. Either manual or automatic titrations may be made. The instrument is alternating current line-operated. It is very stable and gives titration results of good precision which are obtained by calculation from Faraday's law. (auth)

11797

SCINTILLATION DETECTOR FOR SLOW NEUTRONS. Miroslav Vorisek (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J.

Phys. 7, 396-407(1957). (Translated from Referat. Zhur. Fiz. No. 6, 1958, Abstract No. 12460.)

A mixture of ZnS (Ag) and B_2O_3 was investigated with an aim toward using it for detection of thermal and resonant neutrons. The ratio of the ZnS (Ag): B ranging from 8:1 to 12:1 is optimum from the point of view of the efficiency with respect to neutrons, and of the form of the integral spectrum. The best thickness of the layer of the mixture is 0.75 to 1.0 mm. For these optimum values, the efficiency of the mixture with respect to neutrons is 25% at a low background of gamma rays. At a strong background of gamma rays, it is possible to reduce the background to $10^{-7}\%$ with the aid of a discriminator, and the efficiency for neutrons remains not less than 5%.

11798

DIRECT COUPLED SINGLE CHANNEL PULSE HEIGHT ANALYZER. C. Cottini, E. Gatti, and P. Principi (CISE Labs., Milan). Energia nucleare (Milan) 6, 73-6 (1959) Jan.

A lengthener circuit provides a flat top to the input pulses to which two standard step pulses are subsequently added. The height of the second step determines the channel width. The only transitions of an output Schmitt discriminator selected are those which correspond to a triggering caused by the leading edge of the second step superposed on the input pulses. (auth)

11799

A PORTABLE CALIBRATOR FOR β - γ SURVEY INSTRUMENTS USING Sr^{90} . C. T. Nelson (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Health Phys. 1, 447-8(1959) Mar.

A Sr^{90} source and its associated manipulating equipment and shielding are described. The arrangement makes it possible to calibrate β - γ detection instruments locally without routine use of a stationary gamma facility. The instrument minimizes radiation exposure to personnel, saves time, and costs only about \$200 including the source. (T.R.H.)

11800

WORK FUNCTION OF ELECTRONS AND PROPERTIES OF GEIGER-MUELLER COUNTERS. Otto Orient. Magyar Fiz. Folyóirat 5, 395-403(1957). (Translated from Referat. Zhur. Fiz. No. 8, 1958, Abstract No. 17353.)

An investigation was made of the influence of the work function of electrons from the material of the cathode of self-quenching Geiger-Mueller counters on their parameters. Cathodes of zinc, cadmium, copper, and nickel were investigated. If the filler and the geometry are the same, counters with cathodes having a larger work function have a longer plateau and a smaller slope than counters with cathodes having a smaller work function. In counters with different cathodes, for identical overvoltages, the quantity of electricity per discharge are approximately the same. This indicates that the number of formed ions is independent of the material of the cathode.

11801

ESTIMATION OF TRITIO-METHANE IN GM COUNTERS. E. Herczyńska (Inst. of Nuclear Research, Warsaw). Naturwissenschaften 46, 169-70(1959).

A method for the counting of H^3 -labeled organic compounds in Geiger-Mueller tubes is described. Commercial-grade aluminum carbide is purified by heating the finely powdered carbide to 200°C under

vacuum until 10^{-3} mm Hg is obtained. The generation of methane-T by the reaction of the carbide with tritiated water is done as for proportional counting (Nature 166, 628(1950)). The apparatus used, preferably with an external cathode counter, is described. Internal cathode counters lose an effective plateau after prolonged use. (J.S.R.)

11802

RADIATION DETECTORS. 2. THEIR EFFICIENCY. W. R. Loosmore (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power 4, No. 36, 97-101(1959) Apr.

The efficiency of radiation detection instruments for different types of radiation are discussed. The detection of charged particles, gamma radiation, and neutrons in gas ionization chambers is considered along with scintillation detectors. (W.D.M.)

11803

AN ALL-STEEL GAS PROPORTIONAL COUNTER. Denis Aliaga-Kelly. Nuclear Power 4, No. 36, 111-12 (1959) Apr.

A gas proportional counter designed for a particular application is described. The unit is constructed throughout of stainless steel and is a 4π counter in which four counting annuli surround a central thin tube which forms the window of the counter. The anode wires are tungsten and the insulators are of the metal-to-ceramic type. All welds were made by the argon-arc process. (W.D.M.)

11804

WALL AND END EFFECTS IN CYLINDRICAL NEUTRON COLLISION COUNTERS. Josef Rembser (Univ. of Frankfurt am Main). Nukleonik 1, 167-71(1959) Apr. (In German)

The proton spectrum in a cylindrical neutron collision counter with hydrogen-rich filler gas was calculated for a monochromatic neutron beam parallel to the axis. The numerical discrepancies between the results of Rossi and Staub (Ionization Chambers and Counters, p.155, New York, McGraw-Hill, 1949) and those of Skyrme, Tunnicliffe, and Ward (Rev. Sci. Instr. 23, 204(1952)) on the wall and end effects in cylindrical counters are explained. It was proposed to utilize the boundary effects in a long collision counter for energy measurement of fast neutrons. (tr-auth)

11805

A HIGH CURRENT GENERATOR FOR ION AND ELECTRON BEAMS. H. Fröhlich (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonik 1, 183-8(1959) Apr. (In German)

The use of fast electrons and ions in the manufacture or purification of numerous materials produces increasing technical significance. The industrial utilization necessitates the existence of a generator for electrons or ions with sufficient power output. The construction and performance of such a generator are described. It produces electron currents up to 7.5 amp and hydrogen ion currents of 1 amp in continuous operation. In the pulse range, these values, according to the pulse length and frequency, can be increased many-fold. (tr-auth)

11806

AN ELECTRONIC FILTER FOR THE PRECIPITATION OF RADIOACTIVE AEROSOLS. W. Riezler and W. Kern (Univ. of Bonn). Nukleonik 1, 191-5(1959) Apr. (In German)

An electronic filter for the precipitation of radioactive fission products from the atmosphere is described. The filter cross section is $80 \times 80 \text{ cm}^2$, the air throughput is $1700 \text{ m}^3/\text{hr}$, and the degree of precipitation is 70 to 90%. The theory of the particle charge and precipitation, as well as the advantages and disadvantages of the electronic filter in comparison with the conventional fiber filter, are discussed. (tr-auth)

11807

A WAVE-LENGTH SHIFTER FOR ČERENKOV RADIATION IN WATER AND AQUEOUS LEAD SALT SOLUTION. K. Saito and K. Suga (Univ. of Tokyo). Nuovo cimento (10) 11, 600-5(1959) Feb. 16.

An increase factor of 4.4 in photomultiplier pulse height was obtained by the use of pure amino G acid as a wave-length shifter for Cherenkov radiation in water. Further attempts were made to use this compound in a concentrated lead salt solution (1 M), and an increase factor of 1.8 was recorded with the lead ion in the form of its ethylenediaminetetraacetate (EDTA) complex. (auth)

11808

THE CHEMICAL PROBLEMS OF THE CONSTRUCTION OF A HALOGEN-FILLED GM COUNTER MADE FOR CHEMICAL MEASUREMENTS. E. Juhasz and Z. Demjén (Technischen Univ., Budapest). Periodica Polytech. (Chem. Eng.) 2, 265-8(1958). (In German)

Geiger-Mueller tubes filled with rare gas and using halogen gas as quencher have practically an unlimited life. However, the halogen reacts with the cathode and anode. Therefore, a tube with SnO_2 cathode was constructed for the measurement of the activity of liquids. Measurements of the bromine concentration were made with respect to the plateau length, the plateau slope, and the sensitivity. It was established that the plateau length was independent of the bromine concentration, but the slope has a minimum. The relative sensitivity increases sharply with a decrease in the bromine concentration. (tr-auth)

11809

RELATIVE PULSE HEIGHT OF PROTONS AND ELECTRONS IN KI(Tl). Paul Kienle (Brookhaven National Lab., Upton, N. Y.) and R. E. Segel (Wright Air Development Center, Wright-Patterson AFB, Ohio). Phys. Rev. 113, 909-11(1959) Feb. 1.

The relative scintillation efficiency for protons and electrons in KI(Tl) was measured in the energy range of a few Mev. Protons were found to give a greater light output than electrons, and a pulse-height ratio $p:e = 1.42:1$ was determined. (auth)

11810

NUCLEONIC MEASUREMENT OF THE THICKNESS OF ROLLED STEEL AND OF TIN COATING. M. I. Lanin. Primenenie Radioaktiv. Izotopov v Chernoi Met. 190-201(1957). (Translated from Referat. Zhur. Met. No. 4, 1958, p.324.)

The problem of evaluating the precision of thickness measurement by absorption and reflection are examined. Instruments for measuring the thickness of rolled steel and Sn coatings are based on the compensation (null) method of measurement, combining the advantages of the method of comparison with that of absolute measurement. The principle of operation of the instrument consists of measuring the stream of radiation passing through the material against a compensating flux, the magnitude of which changes as a separating shield is introduced. The position of the shield at the instant when

the fluxes are equal serves as a measure of the thickness of the material being inspected. A block diagram of the instrument is appended, and its design is described. It is stated that three models of the instrument have been developed thus far: one to measure thickness in the 5 to 150 micron range, one for the 30 to 1000 micron range, and one for the 2 to 10 micron range. The maximum error is 1.5 to 3% of the value measured. The instruments are capable of being connected to automatic recording devices or to systems for the automatic control of the rolling mill screwdown.

11811

ANALYSIS BY BETA-RAY REFLECTION. G. G. Valov, A. V. Dobrzanski, and A. A. Zhukhovitskii. Trudy Nauch. Tekh. Obshchestva Chernoi Met. 4, 22-9(1956). (Translated from Referat. Zhur. Met. No. 5, 1958, p. 296.)

An instrument for analysis of the percentage content of heavy elements by beta diffraction is described. Ti^{204} , with a half life of 2.7 years, is used as a source of beta radiation. The immediate and prospective values of this new method are discussed. (W.D.M.)

11812

SCINTILLATION COUNTERS FOR GEOLOGIC USE. W. W. Vaughn, V. C. Rhoden, E. E. Wilson, and Henry Faul. U. S. Geol. Survey Bull. 1052-F. 1959. 32p. \$0.35(GPO)

A small light hand-portable scintillation counter, an airborne-carborne scintillation counter, and a portable scintillation gamma-ray well-logging instrument have been designed, constructed, and tested, and are now commercially manufactured. The amplifier circuits take full advantage of the high counting rate that can be obtained from photomultipliers and phosphors. Relaxation-oscillator-type high-voltage supplies provide regulated voltages for the photomultiplier tubes. The portable-hand scintillation counter was designed to be carried when prospecting on foot. The airborne-carborne unit is primarily intended for broad-area reconnaissance from automobiles or light aircraft at altitudes of 500 feet or less. This instrument uses a sodium iodide crystal 3 inches in diameter and $1\frac{1}{2}$ inches thick and a photomultiplier tube with a cathode diameter of 3 inches. Larger crystals may be adapted. Variations in the geometry of the measurement (mass effect), and the degree of radioactive equilibrium of an exposed surface make it impossible to calibrate the instruments directly in terms of uranium content. However, the instrument can be calibrated in milliroentgens per hour if the type of radiation is specified. The portable scintillation gamma-ray well-logging instrument has a manually operated reel and is capable of logging holes 1,000 feet deep. The probe contains only the photomultiplier tube and matching circuit. The energy resolution of the instrument using a cesium source is approximately 10 %, measured through the 1,000 feet of coaxial cable. The portable scintillation gamma-ray well-logging instrument was designed for dual application—as an aid in stratigraphic studies and to log ore-grade material. The wide range of sensitivity is accomplished by adjustments made at the surface. A sample calibration chart for determining the grade of material in a drill hole is included. (auth)

11813

SPARK COUNTER FOR SLOW NEUTRONS. A. Dzownicka and J. A. Janik (Jagiellonian Univ., Kharkov). Zeszyty Nauk Uniwers. Jagiel., Ser. Nauk Mat. Przyrod.,

Mat. Fiz. Chem. 2, (6), 37-48(1956). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19749.)

A spark counter, which registers slow neutrons, has a cathode made of a copper plate covered with boron and an anode of six wires 0.08 mm in diameter, stretched at a distance of 1.5 mm above the plate. The plateau of the counter for neutron registration is approximately 1,000 volts. The center of the plateau is near 4500 volts. The counter efficiency is approximately 0.01% of slow neutrons incident on the cathode.

11814

IONOGRAPHIE. LES EMULSIONS NUCLEAIRES. PRINCIPES ET APPLICATIONS. (Ionography. Nuclear Emulsions. Principles and Applications.) Pierre Demers. Montreal, University Press, 1958. 866p.

The book, which is at the same time both a treatise and an encyclopedia, attempts to present a general view of the experimental and theoretical problems of nuclear emulsions. A brief history of the use of nuclear emulsions is given as an introduction. The first two parts of the book discuss the preparation of special emulsions. The experimental conditions for the use of ionography are described in the third part. The fourth part describes the measurements and observations made with the aid of laboratory sources. The fifth part assembles and discusses critically the work done on cosmic radiation. In the last part of the book, the different applications in the fields of geology, biology, and hygiene are reviewed. A bibliography containing almost 4500 references, of which nine-tenths have been published since 1946, is given. (J.S.R.)

11815

GEIGER-MÜLLER TYPE COUNTER TUBE. (To Atomic Energy of Canada, Ltd.). British Patent 812,183. Apr. 22, 1959.

A halogen-quenched Geiger-Mueller tube design is offered which is sensitive in a high range and a low range and also has a variable sensitivity ratio for β and γ radiation. Six tube configurations are described in which either the central anode or the outer cathode is conical or so shaped that the space between anode and cathode is varied. This variation permits operation as two counters without the disadvantages commonly incurred in parallel counter operation. (T.R.H.)

METALLURGY AND CERAMICS

11816 AECU-4093

Olin Mathieson Chemical Corp. Metallurgical Labs., New Haven.

INVESTIGATION OF THE EFFECTS OF FABRICATION VARIABLES ON THE CORROSION RESISTANCE OF ZIRCALOY-2. H. S. Kalish, H. M. Cobb, and D. W. Coate. Mar. 16, 1959. 134p. Contract [AT(36-1)-47]. (NFR-59-3). \$21.30(ph), \$6.90(mf) OTS.

An investigation was conducted of the effect of melting and fabrication variables on the corrosion of Zircaloy-2 in 750°F steam at 1500 psi. Two 12 in. diameter production-type ingots and three 4 in. diameter laboratory type ingots were produced representing primary and secondary melting in 75% He-25% Ar atmosphere, primary melting in 75% He-25% Ar and secondary melting in vacuum, and primary and secondary melting in vacuum. Variations were performed in the ingot forging procedures, hot rolling temperatures, homogenization treatment and final heat treatment of the hot rolled

Zircaloy-2 strip. Corrosion data were obtained on the strip produced from the large ingots after intervals of 14, 28, 56, 70, 84, and 112-day intervals. Corrosion data were obtained on strip produced from the small ingots at 14 and 28-day intervals. (auth)

11817 ANL-5712

Argonne National Lab., Lemont, Ill. PRELIMINARY EXPERIMENTS ON IRRADIATION CYCLING AND PARTIAL BETA-PHASE IRRADIATION OF URANIUM. Work completed June 1955. J. H. Kittel. Apr. 1959. 21p. Contract W-31-109-eng-38. \$0.75(OTS).

A group of uranium specimens were irradiated under conditions in which some of the specimens were irradiated continuously while others were cycled in and out of a reactor. Although most of the specimens were irradiated under conditions in which they were entirely in the alpha phase, some were irradiated so that their centers were above alpha-phase temperatures. Both highly textured material (300°C rolled) and nominally randomly oriented material (300°C rolled and beta-quenched) were studied. It appeared that irradiation cycling of both types of material may result in greater elongation than would be anticipated on the assumption that the effects of irradiation and thermal cycling acting alone were additive. The material rolled at 300°C showed no external effects due to central irradiation temperatures being above those limiting the alpha phase. However, beta-quenched material, which was irradiated so that central temperatures were above those required for stability of the alpha phase, developed severe distortions which were greater under cycling conditions. It was also noted that 300°C rolled uranium begins to elongate under irradiation at burnups as low as 0.0002 a/o (2 Mwd/t). (auth)

11818 ANL-5887

Argonne National Lab., Lemont, Ill. PREFERRED ORIENTATION IN ROLLED AND IN RECRYSTALLIZED HIGH-PURITY URANIUM ROD. Final Report of Metallurgy Program.4.1.17. M. H. Mueller and H. W. Knott. Apr. 1959. 16p. Contract W-31-109-eng-38. \$0.50(OTS).

The preferred orientation of a relatively small piece of high-purity uranium rod, rolled to an 85% reduction at 300°C, has been determined in the as-rolled and in the recrystallized conditions. The 12 different charts obtained indicated that the as-rolled texture could be described as a duplex (041) and (352) with the (041) being the major component and with considerable spread about each component. The recrystallized rod showed approximate (041) and (392) components with considerable spread. These texture components for both the as-rolled and the recrystallized rods are not too different from those previously reported for reactor-grade uranium rod. However, it was noted that the texture appeared to be quite sharp for the reduction used, and the maximum intensity on an inverse pole figure was considerably displaced from the periphery of an (001) standard projection for both the rolled and recrystallized rods. (auth)

11819 ANL-5975

Argonne National Lab., Lemont, Ill. METALLURGY DIVISION ANNUAL REPORT FOR 1958. Mar. 1959. 125p. Contract W-31-109-eng-38. \$2.75(OTS).

Engineering Metallurgy. The fuel matrix for the TREAT reactor consists of a uniform dispersion of

U_3O_8 in graphite. Some of the developments that led to the fabrication procedure are described. The fabrication of the fuel elements for the ALPR has been completed. The elements are Al-clad thin plates arranged in parallel assemblies, each assembly consisting of 9 plates. The fuel core material is an Al-base alloy containing 17.5 wt. % highly enriched U-2.0 wt. % Ni-0.5 wt. % Fe. Fabrication procedures are summarized. In support of the development of fuel material for the EBR-II, an experimental survey was made of the engineering properties of the reference alloy: 70 wt. % U-20 wt. % Pu-10 wt. % fission. The specimens used were machined from injection-cast rods, either 0.145 inch or 0.250 inch in diameter by 15 inches long. Development work was initiated for the manufacture of the highly enriched U core for the Fast Source Reactor. Irradiation evaluations of various experimental fuel and control rods consisting of U-Mo, U-Th, Al- U_3O_8 , Al-Pu, and ThO_2-UO_2 are presented. Preparation and properties of experimental ceramic fuel materials UC, UO_2-ZrO_2-CaO , UO_2-ZrO_2-MgO , $UO_2-Al_2O_3$, UO_2-MgO , ThO_2-UO_2 are presented. The development of water-corrosion-resistant U-Ti, Al, and Mg alloys is presented. Developments in nondestructive testing are reported. The development of steam generator and superheater for EBR-II is presented. Research Metallurgy. Self-diffusion in gamma U has been measured at four temperatures in the region of stability of the gamma phase. The studies on the operative deformation mechanism of single crystals upon compression have been extended to 600°C. Work on determining the principal elastic moduli of single crystals of alpha U at room temperature has been completed. Phase diagrams of U binary and ternary alloys with the following fission product elements have been investigated: U-Rh, U-Ru, U-Mo, and U-Ru-Mo. The preparation of high-purity Pu by fused salt electrolysis is presented. The sintering mechanisms of Al_2O_3 single crystals are reported. The occurrence of the CsCl-type structure in transition element alloys was investigated. Polarization measurements were made in distilled water to determine the relationship between the change in potential and current flowing at corroding metal surfaces. Low-temperature Al corrosion tests are reported. The mechanism of aqueous corrosion of Zr is being investigated. (W.L.H.)

11820 ASAE-26

American-Standard. Atomic Energy Div., Redwood City, Calif.

MATERIALS FOR LIQUID METAL SYSTEMS. William Holman. Oct. 28, 1957. 32p. \$6.30(ph), \$3.00(mf) OTS.

Lecture presented at the Atomic Industrial Forum's Third Course on Reactor Materials, Stanford University, Stanford, California, July 9-19, 1957.

A review of progress in the use of liquid metals is presented. A number of liquid metals are compared, and the general problems of selecting container materials are considered. In addition, a discussion of corrosion mechanisms and corrosion testing methods commonly employed are examined as well as problems encountered with the liquid metals of greatest interest. (J.R.D.)

11821 BMI-1328

Battelle Memorial Inst., Columbus, Ohio.

APPLICATION OF ULTRAHIGH-PRESSURE HIGH-TEMPERATURE EQUIPMENT TO STUDY OF UO_2 REACTIONS. Wendell B. Wilson. Mar. 18, 1959. 36p. Contract W-7405-eng-92. \$1.25(OTS).

Equipment and techniques for high-pressure high-

temperature solid-state studies were developed, and some preliminary results for the reaction of uranium oxides with other oxides were obtained. A new die design was evolved which appears suitable for any work currently contemplated. The maximum capabilities of this new die are as yet undetermined, but its theoretical pressure limit is in excess of 200,000 atm. The die differs from similar equipment in that internal heating of the sample is employed and maximum pressure and temperature can be maintained simultaneously. Most of the preliminary work on materials synthesis was performed at pressures up to 40,000 atm. and temperatures to 1000°C. No reactions were found in the system UO_2 and U_3O_8 with BeO while under pressure. However, a reaction between Sc_2O_3 and UO_2 was detected which was not detected at normal pressure. Sc_2O_3 reacted with U_3O_8 under pressure as it does at ambient pressure. A new high-pressure high-temperature phase of U_3O_8 was produced. Preliminary study of the U_3O_8 pressure-temperature phase diagram was made. The crystal structure of the new U_3O_8 phase has not yet been determined. (auth)

11822 BMI-1332

Battelle Memorial Inst., Columbus, Ohio.

REACTIONS IN THE NIOBIUM-HYDROGEN SYSTEM. William M. Albrecht, W. Douglas Goode, Jr., and Manley W. Mallett. Apr. 1, 1959. 21p. Contract W-7405-eng-92. \$0.75(OTS).

Equilibria in the niobium-hydrogen system were determined in the range 100 to 900°C, 0.1 to 1000 mm of mercury hydrogen pressure, and hydrogen/niobium atomic ratios of 0.01 to 0.85. X-ray measurements were obtained at 25 to 400°C at hydrogen/niobium ratios up to 0.54. The studies showed that a solid solution of hydrogen in niobium is produced throughout most of the system. A miscibility gap was found at low temperatures and pressures, with a critical point at about a temperature of 140°C, a hydrogen pressure of 0.01 mm of mercury, and a hydrogen/niobium ratio of 0.3. Sorption rates at 300 to 550°C were initially linear. At higher temperatures, sorption rates were controlled by diffusion in the metal matrix. Diffusion coefficients at 600 to 700°C can be expressed by $D = 0.0215 \exp [(-9370 \pm 600)/RT]$. Desorption rates were lower than those predicted by diffusion. (auth)

11823 CF-59-2-1

Oak Ridge National Lab., Tenn.

HYDROSTATIC JOURNAL BEARING WATER TESTS CONDUCTED IN MODIFIED PK-A PUMP. H. E. Gilkey and P. G. Smith. Feb. 1, 1959. 17p. Contract [W-7405-eng-26]. \$3.30(ph), \$2.40(mf) OTS.

A hydrostatic journal bearing mounted near the impeller of an overhung vertical shaft centrifugal pump was subjected to water testing as a part of the molten salt lubrication investigation at ORNL. Three tests were performed with bearings having radial clearances of 0.003 in., 0.0075 in., and 0.005 in. The first journal and bearing (0.003 in. radial clearance) were found to be heavily scored after testing. Only faint localized scratches were found on the second journal (0.0075 in. radial clearance) and these may have been caused by the many test starts and stops. Localized scratches, somewhat deeper than those on the second journal, were observed on the third journal, but no measurable wear had occurred from testing. An apparent inconsistency was noted in that at the same pump operating condition the bearing load as computed from pocket pressure data

increased by a factor of 1.2 to 1.7 as bearing radial clearance was increased from 0.005 in. to 0.0075 in. The configuration of the submerged hydrostatic bearing used in these tests appears to be satisfactory for use as a lower journal bearing in this size and type of centrifugal pump, at least insofar as operation in water is concerned. (auth)

11824 CRMet-826

Atomic Energy of Canada Ltd., Chalk River, Ont.
THE DIFFUSION AND SOLUBILITY OF HYDROGEN
IN THE ALPHA-PHASE ZIRCALOY-2. A. Sawatzky.
Feb. 1959. 19p. (AECL-786). \$0.50(AECL).

The diffusion of hydrogen in the alpha-phase of Zircaloy-2 was measured in the temperature range 260 to 560°C using the gradient technique. The diffusion coefficient was found to be $D = 2.17 \times 10^{-3} \exp(-8,380/RT) \text{ cm}^2/\text{sec}$. The terminal solid solubility of hydrogen in Zircaloy-2 was determined in the temperature range 260 to 650°C using a modification of the gradient technique. The solubility is given by $C_0 = 8.50 \times 10^4 \exp(-7600/RT) \text{ ppm H}_2 \text{ by weight}$. (auth)

11825 DMIC-46F

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.
DEPARTMENT OF DEFENSE TITANIUM SHEET ROLLING PROGRAM. Status Report No. 4. [Period Covered: January 1, 1958 through December 1958.] H. R. Ogden.
Mar. 20, 1959. 93p. (AD-211437; PB-151065).

The progress made on the Titanium Sheet Rolling Program during the period from January 1, 1958, through December 1958 is summarized. Progress made by each of the contractors in the program is outlined along with discussions of some of the important problem areas. At present, there are four alloys in the program (Ti-6Al-4V, Ti-4Al-3Mo-1V, Ti-1.5Al-16V, and Ti-13V-11 Cr-3Al alloy). Three producers and eight aircraft companies are participating in the program. Phase I, the production of heat treatable sheet alloys, is nearing completion and all contractors in Phase III, evaluation of formability and properties, have started their evaluation programs. Phase II, development of design data, should be started by March 1959. (auth)

11826 EXP-NRX-1303

Atomic Energy of Canada Ltd., Chalk River, Ont.
THE FAILURE OF A STAINLESS STEEL CLAD SWAGED URANIUM OXIDE SPECIMEN IN THE X-2 LOOP. A. S. Bain, G. M. Allison, W. Evans, M. B. Watson, and E. Barnes. Dec. 12, 1958. 15p.

The failure of the X-2-p loop test was caused by an axial split in the stainless steel clad uranium oxide specimen which was fabricated by the cold swaging technique. The split has been attributed mainly to the sheath being cracked from overworking during swaging. Intergranular carbide embrittlement resulting from the annealing procedure enhanced the propagation of the split. Both the swaging cracks and embrittlement were due to the unintentional use of En-58J stainless steel instead of the required AISI 304 ELC. (auth)

11827 IDO-14449

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
CORROSION OF TYPE 316 ELC STAINLESS STEEL IN FLUORIDE-BEARING ZIRCONIUM PROCESS WASTES. T. L. Hoffman and C. M. Slansky. Jan. 9, 1959. 20p.
Contract AT(10-1)-205. \$0.75(OTS).

A study was made of the life of the waste storage tanks

under actual storage conditions in order to provide data for the design of future storage facilities. The work reported involved corrosion studies on specially prepared stainless steel samples and on stainless samples cut from weld coupons prepared at the tank fabrication site. Bench-type corrosion tests were run using synthetic HF process waste solutions and boiling 65% HNO_3 . The corrosion of stainless steels in fluoride-containing process waste indicated type 316 ELC stainless steel as likely material for tank construction. More elaborate experiments are described under bench-scale and plant conditions. (J.E.D.)

11828 IGR-TN/C-419

Gt. Brit. Culcheth Labs., Culcheth, Lancs, England.
NITRIC ACID CORROSION AND POLARISATION OF A AUSTENITIC STEEL—EFFECT OF ADDED SPECIES. T. E. Evans. Nov. 1956. 26p.

The effect of added species on the corrosion of 18/23/Nb austenitic steel in boiling nitric acid is considered in relation to the oxidation potential of the systems. It is shown that stainless steels corrode at an accelerated rate when the standard oxidation potential of redox species added to the solution is between about 1.3 and 1.55. The mechanism of accelerated corrosion involves oxidation of chromium in the oxide film normally present on stainless steels from the Cr-III to Cr-VI oxidation state. This destroys the corrosion resistant properties of the steel. When species which produce accelerated corrosion in nitric acid are present this reaction takes place anodically at a potential of about 1.15 V and is virtually unpolarized. When accelerated corrosion occurs the cathodic reaction is also depolarized and involves reduction of the species responsible for producing accelerated corrosion. However, when stainless steels do not suffer accelerated corrosion the cathodic reaction is different and involves reduction of nitric acid. This reaction is heavily polarized. (auth)

11829 KAPL-2002

Knolls Atomic Power Lab., Schenectady, N. Y.
HABIT PLANE FOR HYDRIDE PRECIPITATION IN ZIRCONIUM AND URANIUM—ZIRCONIUM. F. W. Kunz and A. E. Bibb. Jan. 22, 1959. 10p. Contract W-31-109-Eng-52. \$0.50(OTS).

The distribution of hydrogen, in the 100-ppm range, was found to be of platelet form for Zr and 1 wt. % U-Zr single crystals. The habit planes for the hydride platelets in the Zr crystals were found to be (1122), (1012), and (1121) while the habit planes in the 1 wt. % U-Zr crystals were of the (1231), (1121), and (1123) types. With the exception of the (1231) plane, these have been identified as the twin planes in Zr. The effect of H on the high and low strain-rate mechanical properties of Zr was explained with reference to the findings of this investigation. (auth)

11830 KAPL-M-GLB-1

Knolls Atomic Power Lab., Schenectady, N. Y.
STATISTICAL PROCEDURES FOR CONTROLLING AND ASSURING FUEL PLATE PROPERTIES THAT CAN BE MEASURED ONLY BY DESTROYING THE PLATES. G. L. Burrows. Nov. 21, 1958. 24p. Contract [W-31-109-Eng-52]. \$6.30(ph), \$3.00(mf) OTS.

Some properties of finished fuel plates can be ascertained only by destroying the fuel plates. Consequently, a process inherently capable of producing a high percentage of acceptable plates and statistical quality control of all phases of the fabrication process are necessary to minimize the cost of destructive sampling of finished

plates. A procedure is outlined for the control of the fabrication process and for destructively sampling finished plates in order to assure that plate specifications are met. An example details the calculations required and the interpretation of their results. The procedure is recommended for use in complying with destructive sampling quality assurance requirements as set forth in MIL Specification (LATER). (auth)

11831 KAPL-M-HOS-6

Knolls Atomic Power Lab., Schenectady, N. Y.

SUSCEPTIBILITY OF AISI 410 TO STRESS CORROSION CRACKING IN HIGH TEMPERATURE, HIGH PURITY WATER. Henry Suss. Feb. 16, 1959. 36p. Contract W-31-109-Eng-52. \$6.30(ph), \$3.00(mf) OTS.

AISI-410 stainless steel tempered at 650°F to hardness of RC 36 to 42 was being considered as the material for a highly stressed part of a pressure-retaining member in contact with high-purity, high-temperature water. The AISI-410 did not indicate susceptibility to stress-corrosion cracking in hydrogen ammoniated (pH 8.5 to 9.5) or hydrogen-lithium hydroxide waters (pH 11) at 300°F for six months exposure. Nickel and chromium plates were also tested for stress-corrosion cracking in the same systems. Results are included. (W.L.H.)

11832 LA-1381

Los Alamos Scientific Lab., N. Mex.

AN ANALYSIS OF PROJECT DATA ON THE CORROSION OF URANIUM IN VARIOUS MEDIA. James T. Waber. Dec. 22, 1948. Decl. Mar. 26, 1957. 47p. Contract W-7405-eng-36. \$7.80(ph), \$3.30(mf) OTS.

This is a summarizing and reviewing report in which almost all the experimental data representing project work done prior to 1949 on the corrosion of pure uranium are brought together and analyzed. New data obtained in this laboratory on corrosion rates in laboratory atmosphere and on the identification of corrosion products by electron diffraction are included. The data for corrosion in each of several different media have been plotted according to logarithm-of-the-rate versus reciprocal-temperature coordinates; and from these plots values for the energies and entropies of activation of the corrosion reactions have been obtained. By theoretical treatment of the role of oxygen as a negative catalyst, it is shown that this element may be expected to "poison" the corrosion reaction and thus act as a corrosion inhibitor. A practical significance of these data analyses is that they explain why uranium stored in inert atmospheres (helium or argon) containing only very small amounts of water vapor will corrode relatively rapidly with the formation of loose powdery oxide, whereas uranium may be kept in dry air almost indefinitely with formation on surfaces of only a discoloring, but adherent, oxide coating. (auth)

11833 LA-2287

Los Alamos Scientific Lab., N. Mex.

THE ETCHING OF PLUTONIUM AND ITS ALLOYS BY CATHODIC BOMBARDMENT. Katherine Imlah. Jan. 6, 1959. 43p. Contract W-7405-eng-36. \$1.25(OTS).

The development of microstructural detail by cathodic bombardment has been used successfully for many metals and alloys which are difficult to etch by conventional methods. An application of this technique to plutonium and its alloys is presented. A method for preventing the specimen from overheating is included in the description of the equipment. Photomicrographs of a few clean, well defined microstructures obtained by cathodic bombardment of plutonium and some of its alloys are also

included, together with photomicrographs of the same specimens etched by means of conventional techniques. (auth)

11834 MAB-139-M(1)

National Research Council. Materials Advisory Board. FIRST PROGRESS REPORT OF COMMITTEE FOR DEVELOPMENT OF MANUFACTURING PROCESS FOR AIRCRAFT MATERIALS (AMC). Mar. 24, 1959. 63p.

The committee was organized into subpanels to study the fields of: aircraft applications, castings and powder metallurgy, forgings and extrusions, machining and machine processes, plastics, chemicals and optics, rolling, cold extrusion and cold forming, and sandwich materials and joining. (W.L.H.)

11835 MAB-139-M(MI)

National Research Council. Materials Advisory Board. REVIEW, EVALUATION AND RECOMMENDATIONS OF PROPOSED AND ACTIVE MACHINING PROJECTS OF AMC MANUFACTURING METHODS DIVISION. Feb. 27, 1959. 22p.

The panel's evaluations and recommendations on each of the twenty-four projects reviewed on machinability of various alloys and high-temperature materials are summarized. (W.L.H.)

11836 MND-DB-2522

Martin Co. Nuclear Div., Baltimore.

DEVELOPMENT OF IRON-ALUMINUM BASE ALLOYS FOR GAS COOLED REACTOR COMPONENTS. Quarterly Progress Report No. 2 [for] March 1 through May 31, 1958. J. Mueller. June 1958. 83p. Contract AT(30-3)-325. \$2.25(OTS).

A program was undertaken to develop an Fe-Al base alloy for service at 1600°F. The program includes development of an alloy, development of techniques for fabricating fuel elements, reprocessing investigations, and irradiation testing of Fe-Al base alloys. The Martin-Nuclear alloy (DB-Z) was used as a starting point in determining the effects of Al, Cr, Ti, Nb, Zr, and Ni on the properties such as maximum ductility. Zr was found to be most effective in eliminating sharp peaking of the ductility curve thus permitting the use of high annealing temperatures. The other elements generally tended to increase the tendency toward peaking of the ductility curve and/or produced shifts of the peak toward lower annealing temperatures. Stress rupture and oxidation data for these alloys are reported. Heat treatment studies were conducted on the alloy to determine the aging temperatures and precipitate relationships, the effect of precipitation on the ductility of the embrittled condition and the ductility changes associated with long time aging. Microstructure versus ductility comparisons were made. Two statistically designed experiments were carried out to determine the effects of several elements on the properties of Fe-Al base alloys while in the presence of one another. An exact balance experiment was used involving additions of Zr, Nb, and Mo to a base alloy of Fe-Al-Cr. Analyses are made of the tensile, stress rupture, and oxidation data. A multiple-balance experiment was used to determine the effects of six elements in a group of 25 alloy combinations. The elements involved in this experiment were Al, Cr, Ti, Nb, Mo, and Si. The experiment was modified after an evaluation of a preliminary group of ten of the alloys. Changes were made in some ranges of the additions and zirconium was added to the experiment. Analyses are made of the tensile and stress rupture data of the complete group of 25 alloys. Several comparisons

are made between C-containing alloys and alloys of similar composition prepared without C additions. Improvements in ductility and stress rupture life attributable to C are shown. Results of pressing, sintering and rolling studies related to Fe-Al alloy powder product fabrication are described. Powder products produced from elemental, pre-alloyed and combined master alloy powders were considered. Small additions of Sm to elemental powder mixtures were used and found to promote sintering to form a more dense product. Determinations were made of reaction rates in solutions of acids used in reprocessing fuel elements. Results are given for alloys selected from the many prepared in the development program. Tensile test samples of two iron-aluminum base alloys were inserted in the Materials Testing Reactor for irradiation effects determination. The alloys consisted of a binary Fe-Al alloy and one of the DB-2 alloy compositions. (auth)

11837 NAA-SR-Memo-723

North American Aviation, Inc., [Downey, Calif.].
THE PREPARATION OF DIMENSIONALLY STABLE BORON-CONTAINING GRAPHITE BODIES. Charles R. F. Smith. June 16, 1953. Decl. Nov. 6, 1958. 9p. \$1.80(ph), \$1.80(mf) OTS.

A dimensionally stable boron-containing graphite body was developed for the use of the Sodium-Graphite Reactor project. Several methods of preparing such a body were investigated. These include graphite impregnated with borax, graphite-B₂O₃ bodies warm pressed, graphite-B₂O₃ bodies hot pressed and annealed, and graphite-MgO-B₂O₃ bodies hot pressed and annealed. By the last of these methods a body was formed which was structurally sound. After annealing at 850°C, this body showed less than 0.2% expansion in any dimension when cycled through an 800°C temperature range. X-ray examination showed the mixed oxides to exist as crystalline compounds having the composition 2MgO·B₂O₃ and 3MgO·B₂O₃. (auth)

11838 NAA-SR-Memo-1171

North American Aviation, Inc., [Downey, Calif.].
EFFECT OF MOLTEN SODIUM ON THERMAL INSULATION SPECIMENS. M. Tarpinian. Nov. 19, 1954. 8p. \$1.80(ph), \$1.80(mf) OTS.

Every type of thermal insulating material tested showed attack in varying degrees. Many specimens which had been cured at 1000°F, with no color change, did show drastic changes at 950°F due to the action of sodium. The materials showing the least disintegration and greatest preservation of mechanical properties were Superex paste and Eagle-Picher mineral wool. The uncured Superex Block did not hold up as well as Superex paste, presumably due to the presence of water of crystallization; after curing, the results were similar to that of the paste. The refractory clays showed the greatest degree of destruction. The time element is of vital importance, since a long period of contact with liquid sodium would presumably result in complete destruction of every specimen tested. (auth)

11839 NAVORD-5518

Naval Gun Factory, Washington, D. C.
CLEANING AND PASSIVATION OF CORROSION RESISTING STEELS. Lancaster Lowry and Joseph Thompson. [July 1956]. 26p. \$0.75(OTS). (NGF-T-28-57; PB-131964).

Cleaning methods for removing surface contaminants such as scale, flux, slag, metallic lubricant, and iron from the surface of corrosion-resisting steels, and

the functions of passivating treatments in nitric acid solutions as a final cleaning operation are examined. The rate of attack of nitric-hydrofluoric acid pickling solutions employed to remove scale or as a whitening solution following other methods of scale removal and that of nitric acid passivating solutions was evaluated with typical steels of the AISI Type 200, 300, and 400 series. The effect of chloride contamination of passivating solutions on the rate of attack was also evaluated, as well as the effects of carbide precipitation. (auth)

11840 NMI-FR-13

Nuclear Metals, Inc., Cambridge, Mass.
FEASIBILITY REPORT FOR CASTING AND EXTRUDING URANIUM-THORIUM FUEL RODS FOR ATOMICS INTERNATIONAL. Job No. 2121. W. L. Larson. Sept. 30, 1957. 33p. Contract AT(30-1)-1565. \$6.30(ph), \$3.00(mf) OTS.

The melting, casting, and extrusion of a 7.6 wt. % U-92.4 wt. % Th alloy (U enriched in U²³⁵ to ~93%) are presented. (W.L.H.)

11841 NP-7384

[Japan. Atomic Energy Research Inst., Tokyo.]
SEVERAL PROPERTIES OF METALLIC URANIUM. [Report] No. 1. 1957. 61p.

Various properties of uranium are reviewed including melting and casting, processing, cladding, physical metallurgy, radiation damage, corrosion, and general alloying properties. (W.D.M.)

11842 NP-7388

Ohio State Univ. Research Foundation, Columbus.
THE OXIDATION CHARACTERISTICS OF COLUMBIUM ALLOYS. Technical Report 467-5. Gerald Gordon, Coulson Scheuermann, and R. Speiser. Mar. 1959. 56p. Contract N6onr-22528.

A survey of the available data pertaining to the niobates showed that in most cases the melting points are above 1200°C and are, therefore, not a fruitful basis for screening. The binary niobium-titanium system was investigated for oxidation resistance at 860°C. Alloys in this system, particularly one containing 48 at. % niobium, 52 at. % titanium, exhibited very good oxidation resistance at temperature, but spalled violently upon cooling. In an attempt to suppress spalling of the niobium-titanium alloys, chromium was added as a ternary addition. Chromium further increased the oxidation resistance but had little effect on the spalling behavior. Alloys containing chromium were brittle and difficult to fabricate. It was found that, at 1000°C, progressive additions of zirconium greater than 10 at. % to niobium decreased the oxidation rate and increased the protective nature of the oxide scale formed (6ZrO₂·Nb₂O₅). A minimum in the oxidation rate occurred at about 55 at. % zirconium. The oxide scale formed on an alloy containing 57 at. % zirconium was protective at 1000°C for times up to five hours and did not spall upon cooling. After five hours at 1000°C there is a rapid increase in the oxidation rate (break-away) which is associated with the formation of a bulky, porous oxide at the specimen edges. At 1100°C the oxidation rate follows a parabolic relationship for at least 17 hours at temperature. High zirconium alloys were found to undergo both internal and external oxidation. Titanium was added as a ternary addition in an attempt to decrease the oxidation rate and to suppress the rapid increase in weight gain which occurs after several hours in the niobium-zirconium alloys. One alloy, 50 at. % Zr,

45 at. % Nb, 5 at. % Ti, was found to possess an excellent combination of low oxidation rate and protective, non-spalling oxide film. This alloy could be fabricated by the usual techniques. Oxidation tests were run on specimens of this composition at temperatures from 900 to 1200°C. At each temperature the specimens undergo rapid initial weight gains. After several hours the oxidation rate drops considerably in such a way that the weight gain increment during the first five hours nearly equals that of the next 95 hours at 1000°C. The break-away occurring in the niobium-zirconium binary alloys was suppressed by the addition of titanium. The oxidation behavior at 900 and 1000°C can best be described by a quartic relationship, $w^4 = kt$. This unusual relationship appears to result from the process of subscale formation. The subscale manifests itself as a lamellar dispersion of oxide phases. This dispersion may increase the high temperature strength while decreasing the available ductility. Chromium additions to the best niobium-zirconium alloys gave relatively good oxidation resistance at 1100 and 1200°C, but the breakaway phenomenon was observed after 10 hours at 1000°C in an alloy containing 45 at. % Nb, 45.7 at. % Zr, 9.3 at. % Cr. The addition of chromium was found to embrittle the alloys by the formation of a second phase. (auth)

11843 NP-7398

Mine Safety Appliances Co., Callery, Penna.
RADIOACTIVE LEAK EXPERIMENTS. Progress Report No. 5 [for] October 22, 1954-January 21, 1955. Memo Report 76. R. J. Campana and J. W. Mausteller. Jan. 25, 1955. 4p. Contract NObs-65426.

Run 4 was made during the week of Nov. 30-Dec. 3. The leak rate was 1 to 3 lph, for 20 hr, using 90 mc $\text{Na}_2^{24}\text{CO}_3$ and a leak between gasket faces. Object of this run was to verify results from Runs 1 to 3. Results were not calculated, it being desired to do some calibration of instrumentation using Na^{24} in hopes of obtaining a better material balance, and to verify absolute quantities of activity caught on filters. This has been done and results are being correlated for calculation of Run 4 and any corrections which may be indicated for prior runs. Changes have been made in autoclave temperature control mechanisms which should permit holding a more constant leak rate and facilitate leak rate measurement. The next run will explore the effect of compartment wall temperature on activity behavior. After an activity equilibrium is reached at ~100°F wall temperature, the compartment walls will be cooled with atmospheric air to determine any changes in compartment air activity. (auth)

11844 NP-7399

Mine Safety Appliances Co., Callery, Penna.
RADIOACTIVE LEAK EXPERIMENT. Progress Report No. 6 [for] January 22 to February 18, 1955. Memo Report 77. R. J. Campana and J. W. Mausteller. Feb. 18, 1955. 21p. Contract NObs-65426.

A 4th run has been made in the series of leaking Na^{24} -contaminated water into a 4000 cu ft enclosure. Leak rates were 4.0 and 2.3 lph for 12 and 8 hr each. Equilibrium air activities were 6-7 and 4 $\mu\text{c}/\text{ml}$, attained 4 hr after the leaks started. Evidence of decontamination across the leak has been indicated in this run. Material balances for this and past runs have been greatly improved by instrumentation calibration: > 85% accountability of the leaked activity can be realized. (auth)

11845 NP-7400

Mine Safety Appliances Co., Callery, Penna.
THERMAL SHOCK—REPORT NO. 11. SIR MARK A

EIGHT INCH VALVE BODY-SEAT RING MOCK-UP NO. 2. Memo Report 78. J. K. Richter, M. M. Shrout, and G. E. Kennedy. Feb. 15, 1955. 9p. Contract NObs-65426.

The second of a series of three valve body-seat ring mock-up specimens was subjected to 1000 thermal transients in which the stream temperature changed from 850 to 630°F in $1\frac{1}{2}$ seconds. From external indications, the weld under test was apparently unaffected. (auth)

11846 NP-7403

Mine Safety Appliances Co., Callery, Penna.
TYPE SS GA-3 ELECTRIC CABLE TEST WITH SODIUM. Memo Report 83. V. K. Heckel and E. C. King. May 9, 1955. 3p. Contract NObs-65426.

The effects of Na on SS GA-3 electric cable were examined. The cable is considered as replacement for the M. I. cable specified for the SSN 575. The cable is described, along with test procedures and results. It was concluded that further tests are required before a recommendation can be made. (J.R.D.)

11847 NP-7404

Mine Safety Appliances Co., Callery, Penna.
TEST OF THIRD FLUID VALVE FOR USE WITH NaK. Memo Report 84. W. Milich and E. C. King. June 14, 1955. 7p. Contract NObs-65426.

A $\frac{1}{4}$ in. bellows "Hoke" valve designed for use with mercury in the third fluid system of Mark B was tested and proved satisfactory for use with NaK-78. The valve was found to be leak tight on the valve body and across the seat by mass spectrometer tests given after each series of the major tests listed: valve open, 600 psig nitrogen pressure over NaK at 70, 125, 250, 375, and 500°F for 1 hr each on valve body; and, 100 cyclic tests of opening and closing with NaK at room temperature at 40 psig, followed by 600 psig across the seat for 1 hr. (auth)

11848 NP-7406

Mine Safety Appliances Co., Callery, Penna.
THERMAL SHOCK—PRELIMINARY REPORT NO. 12. SIR MARK A EIGHT INCH VALVE BODY-SEAT RING MOCK-UP NO. 3. Memo Report 86. G. E. Kennedy and E. C. King. July 29, 1955. 8p. Contract NObs-65426.

Testing procedures and results are given of thermal shock tests to which an SIR Mark A eight-inch valve body-seat ring mock-up was subjected. The ring weld was unaffected, but the valve body developed a leak. (J.R.D.)

11849 NP-7407

Mine Safety Appliances Co., Callery, Penna.
ABNORMAL TEMPERATURE TEST OF 8 IN. MARK B VALVE BELLOWS. (Alternate II Mid-Point Design.) Memo Report 88. G. E. Kennedy and E. C. King. Aug. 18, 1955. 6p. Contract NObs-65426.

Two 8-in. Mark B valve bellows (alternate II mid-point design) were subjected to abnormally high temperature cycles, simulating valve bellows temperatures at scram conditions. No leaks or unusual damage was found at the completion of the tests and the bellows were returned to KAPL for metallographic examination. (auth)

11850 NP-7408

Mine Safety Appliances Co., Callery, Penna.
RADIOACTIVE LEAK EXPERIMENT. (Run 8). Progress Report No. 10 [for] June 1 to August 15, 1955. Memo Report 89. R. J. Campana, J. W. Mausteller, and

H. E. Cummings, Jr. Sept. 14, 1955. 20p. Contract NObs-65426.

Water contaminated with Mo^{99}O_3 has been leaked through a 7-mil-diam. hole in a pipe wall from a 550°F, 2000 psig loop system into a 4000 cu ft compartment. Three separate tests were made, each consisting of a leak period and a period during which fall-out of air activity was observed. Run 8A was a leak from a lagged pipe; Runs 8B and 8C were from bare pipes. In Run 8A and 8B solution of Mo^{99}O_3 in H_2O was aided by NH_4OH ; no NH_4OH was used in Run 8C. Steam collected under the asbestos cloth covering of the lagging and caused blistering but the lagging remained intact. Maximum air activities of 15, 990, and 630 $\mu\text{c}/\text{ml}$ were reached in 5, 3, and $5\frac{1}{2}$ hr in Runs 8A, B, and C, respectively. An attenuation of air activity of ~ 38 resulted from use of the lagging. In Run 8A, $\sim 60\%$ of the leaked activity was caught in the insulation and 24.5% in the lagging drip-pings. In Runs 8B and 8C, 84% and an estimated 64% of the leaked activity was transferred through the air to the walls. Exponential fall-out coefficients of air activity were 0.323 hr^{-1} , 0.227 hr^{-1} , and 0.215 hr^{-1} , respectively. Comparisons with a previous run using Na^{24} tracer indicate Mo^{99} is the more hazardous air contaminant because of higher specific air activities, longer half-life and more difficult decontamination from walls. (auth)

11851 NP-7410

Mine Safety Appliances Co., Callery, Penna.
PLUGGING LEAKS BETWEEN WATER AND THIRD FLUID SYSTEM (Hg). Memo Report 92. S. J. Rodgers, J. V. Friel, and J. W. Mausteller. Sept. 29, 1955. 16p. Contract NObs-65426.

An investigation was made of sealing methods for leaks between water (or steam) and mercury systems. Leaks simulating tube-to-tube sheet joint cracks were successfully plugged in < 1 hr by adding a commercial boiler sealant (Leakure) or an $\text{Fe}-\text{Fe}_2\text{O}_3$ mixture to the water side. Addition of 1 wt. % magnesium + ~ 1 vol. % Leakure to the mercury system gave plugs in either steam or water leaks. Operating conditions were 500 psig (465°F) on the water side and ~ 300 psig 500°F on the mercury side. Pressures were alternated in some cases. Plugs held 500-800 psi differential pressures both at operating water conditions (atmospheric pressure on mercury side) and at room temperature. (auth)

11852 NP-7412

Mine Safety Appliances Co., Callery, Penna.
ABNORMAL PRESSURE TEST OF 8 INCH MARK B VALVE BELLOWS. (Alternate II Mid-Point Design.) Memo Report 94. G. E. Kennedy and E. C. King. Oct. 18, 1955. 4p. Contract NObs-65426.

Three 8 in. Mark B valve bellows (alternate II mid-point design) were subjected to abnormally high pressures simulating conditions that may be encountered in operation. No leaks were encountered, although there was some distortion between the convolutions on all three bellows. (auth)

11853 NP-7413

Mines Safety Appliances Co., Callery, Penna.
TEST OF A 1 INCH COMBINED VALVE CONNECT AND DISCONNECT. Memo Report 95. W. Milich, E. A. Schultz, and E. C. King. Nov. 21, 1955. 7p. Contract NObs-65426.

A 1 in. combined valve connect and disconnect intended for use in the primary coolant vent lines of the SIR Mark B system was subjected to a series of performance tests.

These tests included valve cover welding tests, a series of static pressure and seat leakage tests, and a series of sodium cycling tests. The static pressure and seat leakage tests were run at room temperature, using nitrogen at 100 and 200 psig. Additional static tests were run at 500°F using sodium at 200 psig. The valve was subjected to 10 cycling tests, where-in sodium at 500°F, 100 psig was pumped through the valve for 10 minute periods. After each cycle the valve disconnect joint was dismantled and rebuilt with a new "O" ring. Performance in all cases was satisfactory. (auth)

11854 NP-7414

Mine Safety Appliances Co., Callery, Penna.
IMPURE COVER GAS EFFECTS: EXPANSION TANK. Memo Report 96. E. F. Batutis, C. A. Palladino, and J. W. Mausteller. Nov. 17, 1955. 11p. Contract NObs-65426.

Operation of a Mark B expansion tank mock-up with 98 vol. % N-2 vol. % O cover gas indicated positive operational difficulties. After 16 days at 1000°F and 4 cycles of draining and purging all components in the gas phase of the system were coated with heavy layers of oxide, after using 277 ft³ of N containing 2.0 vol. % O. The 1 in. \times 2 in. reducer on the gas inlet line became completely plugged, and oxide concentrations in the sodium system became excessive. The test was discontinued and the loop dismantled for complete examination. (auth)

11855 NP-7420

Mines Safety Appliances Co., Callery, Penna.
THERMAL SHOCK TEST OF GRISCOM-RUSSELL TUBE SHEET SPECIMEN. Preliminary Report 13. Memo Report 105. G. E. Kennedy and E. C. King. Feb. 16, 1956. 8p. Contract NObs-65426.

An evaporator tube-to-tube sheet specimen fabricated by Griscom-Russell Company was tested at simulated thermal shock conditions of the S2G system. The test was terminated because of leaks in the third fluid system at a point away from the tube sheet joint. These leaks do not indicate a failure of the tube sheet since they did not occur at this point. (auth)

11856 NP-7425

Mine Safety Appliances Co., Callery, Penna.
THERMAL SHOCK REPORT 14; TRANSITION WELDS BETWEEN TYPE 304 STAINLESS STEEL AND $2\frac{1}{4}\%$ Cr-1% Mo STEEL. Memo Report 115. G. E. Kennedy and E. C. King. July 20, 1956. 7p. Contract NObs-65426.

A thermal shock test applied to a series of six transition welds between type 304 stainless steel and $2\frac{1}{4}\%$ Cr-1% Mo steel is reported. A total of 5000 shock cycles at a temperature change in the NaK stream of 1000 to 500°F in $\frac{1}{2}$ to 1 sec were applied without apparent damage to two of the specimens. The transition welds tested were returned to KAPL for metallographic examination. (auth)

11857 NP-7428

Mine Safety Appliances Co., Callery, Penna.
MINIATURE BOILER TEST. Memo Report 123. E. C. King, W. Milich, and E. A. Schultz. Jan. 7, 1957. 9p. Contract NObs-65426.

Tests were run on two miniature bayonet Type 347 stainless steel boilers. NaK at 800°F was used to heat the water to 488°F (600 psig) which contained the equivalent of 2000 ppm NaK (78% K). The tests were run for 10 days to determine if quantities of caustic of the above

magnitude would cause cracking of the tube sheets if a specified boiler water treatment was used. Visual inspection and a mass spectrometer leak test at MSA and preliminary metallographic examination at B & W indicated that the boilers were not adversely affected by operation with this quantity of caustic. (auth)

11858 NP-7429

Mine Safety Appliances Co., Callery, Penna.
OPERATIONAL HISTORY OF BY-PASS TEE; 3000 KW TEST SYSTEM. Memo Report 116. R. C. Andrews and R. E. Lee. June 27, 1956. 3p. Contract NObs-65426.

The 3000-kw system is being used to life test the S2G model evaporation. The by-pass tee has been subjected to over 9,000 cycles in the system. (W.L.H.)

11859 NP-7430

Mine Safety Appliances Co., Callery, Penna.
MINIATURE BOILER TEST—NAK INJECTION (NO. 1). Memo Report 124. W. Milich, G. E. Kennedy, E. A. Schultz, and E. C. King. Jan. 16, 1957. 12p. Contract NObs-65426.

A test was run to determine the effect of a leak of third fluid NaK into an area of a simulated water side nozzle where temperature measurements have indicated that steam is present. This simulated nozzle was built of type 347 stainless steel. Approximately 1 lb of NaK was injected with nitrogen pressure 600 psig over a period of 11 min through a prepared leak. Within a minute after the NaK injection started, thermocouples located on the outer surface of the boiler in the immediate area of the injection went from 925°F to beyond the 1200°F scale of the instrument. The boiler was operated for ~20 hr after the NaK was injected without any indication of a failure, after which the unit was secured, allowed to cool, and the insulation removed. A pressure test of 125 psig revealed several cracks in the shell (water side), and evidence of NaK was also found in the insulation indicating that leaks occurred during the NaK injection. (auth)

11860 NP-7431

Mine Safety Appliances Co., Callery, Penna.
MINIATURE BOILER TEST—NAK INJECTION (NO. 2). Memo Report 125. W. Milich, G. E. Kennedy, E. A. Schultz, and E. C. King. Feb. 8, 1957. 10p. Contract NObs-65426.

A test was run to determine the effect of a slow NaK leak to the water side nozzle where temperature measurements indicated the presence of superheated steam. Approximately 110 grams (0.242 lbs) was injected over a period of 6½ hours with no indication of a temperature rise due to the water-NaK reaction. The boiler was operated 18 hours after the NaK injection was started before a steam leak was noticed. The system was immediately secured, allowed to cool and the boiler removed from the system. Several cracks were visible in the shell at this time. The unit was then returned to B & W for metallurgical examination. Preliminary examination revealed cracks in both the shell and outer tube. (auth)

11861 NP-7434

MSA Research Corp., Callery, Penna.
A STUDY OF METHODS FOR PREVENTION OF CHLORIDE STRESS CORROSION OF AUSTENITIC STAINLESS STEEL. Progress Report I. Memo Report 133. M. J. McGoff and C. J. Glaser. June 20, 1958. 8p. Contract NObs-65426.

Stainless steels are susceptible to stress corrosion

cracking when exposed to chloride-bearing water. The cracking of nuclear naval vessel piping could be produced from bilge water splashing insulated piping, permeating the insulation and eventually contacting the pipe wall. This project is to investigate the occurrence of chloride stress corrosion of Type 304 stainless steel pipe from this action and evaluate methods which will inhibit attack. A solution to the problem is being sought by experimental procedure and from a survey of industrial experience. (auth)

11862 NP-7435

MSA Research Corp., Callery, Penna.
A STUDY OF METHODS FOR PREVENTION OF CHLORIDE STRESS CORROSION OF AUSTENITIC STAINLESS STEEL. Progress Report II. Memo Report 134. M. J. McGoff and C. J. Glaser. July 15, 1958. 4p. Contract NObs-65426.

Stainless steels are susceptible to stress corrosion cracking when exposed to chloride-bearing water. The cracking of nuclear naval vessel piping could be produced from bilge water splashing insulated piping, penetrating the insulation, and eventually contacting the pipe wall. An investigation of the occurrence of chloride stress corrosion of Type 304 stainless steel pipe from this action and an evaluation of methods which will inhibit attack were made. A solution to the problem is being sought by experimental procedure and from a survey of industrial experience. (auth)

11863 NP-7463

California, Univ., Berkeley. Minerals Research Lab.
EFFECT OF DILUTE COPPER ALLOYING ON THE ACTIVATION ENERGIES FOR CREEP OF ALUMINUM SINGLE CRYSTALS. Technical Report No. 7. D. Walton, L. A. Shepard, and J. E. Dorn. Dec. 1, 1958. 26p. Contract Nonr-222(49).

The activation energies for creep of single crystals of Al containing up to 0.25% Cu in alpha solid solution were determined over the range from 78 to 850°K. Single crystals were prepared from the melt in a special graphite mold. All crystals were seeded for an orientation that yields extensive easy glide in tension. Activation energies for creep were determined by the effect of small changes in temperature on the creep rate. From 78 to 200°K the alloy single crystals exhibited the same activation energy of about 4,000 cal/mole as pure Al crystals. From about 240 to 400°K strain aging prevented the determination of the activation energies since the creep rate was found to be negligible; the plastic strain was found to be essentially a function of the applied stress alone in this range. Between 450 and 490°K the activation energy for creep of the alloys increased from 35,000 to about 41,000 cal/mole; and from 490 to about 700°K, over the range where pure Al single crystals exhibit the activation energy of 28,000 cal/mole for cross slip, alpha solid solution alloys of Al containing 0.09 to 0.25% Cu yielded a new activation energy of 41,000 cal/mole. This high activation energy can be rationalized in terms of a modification of the activation energy for cross slip due to solute atom effects. Above about 800°K the activation energy for creep of the Cu alloys of Al was 36,000 cal/mole, a value coincident with that for the dislocation climb process in high-purity Al. (auth)

11864 NP-7465

California, Univ., Berkeley. Minerals Research Lab.
DEFORMATION AND FRACTURE OF MAGNESIUM

BICRYSTALS. Technical Report No. 6. J. D. Mote and J. E. Dorn. Feb. 15, 1959. 34p. Contract DA-04-200-507-ORD-171.

The effects of piled-up arrays of dislocations on inducing slip, twinning, and fracturing in magnesium bicrystals were investigated. A series of variously oriented bicrystals of magnesium having a vertical grain boundary was prepared and tested in tension. It was found that piled-up arrays of dislocations at the grain boundary could, under appropriate conditions, induce slip, twinning, and cracking. The results that were obtained substantiate, at least qualitatively, the general dislocation mechanism for transmission of strain across grain boundaries and the Petch-Stroh concept of fracturing. (auth)

11865 NRL-5176

Naval Research Lab., Washington, D. C.
CREEP OF A DISPERSION-HARDENED ALUMINUM ALLOY. G. S. Ansell and J. Weertman. June 25, 1958. 20p. Project No. NR-510-000.

The creep behavior of an aluminum alloy hardened with a finely dispersed phase of aluminum oxide was investigated. The as-extruded alloy shows an approximate steady-state creep in which the creep rate depends exponentially on the applied stress. The activation energy of creep is approximately 150,000 cal/mole. The recrystallized alloy shows no steady-state creep. (auth)

11866 NRL-5290

Naval Research Lab., Washington, D. C.
CHARPY-V TRANSITION TEMPERATURES OF FERRITIC IRON ALLOYS. PART I. IRON-OXYGEN AND IRON-ALUMINUM. J. E. Srawley. Feb. 6, 1959. 20p. Project Nos. NS-013-022 and NR-510-000.

The mid-energy Charpy-V transition temperatures of a series of Fe-O alloys and a series of Fe-Al alloys were determined for several conditions of mechanical working and heat treatment. The 50% ductile fracture-appearance transition temperatures were the same as the mid-energy temperatures for all practical purposes. The transition temperature of Fe increased steadily with the O content for any given condition among those studied. For a given O content the transition temperature was higher if the material had been furnace cooled from 1650°F after being cold worked than if it had been oil quenched from 1650°F after cold working. The mode of fracture below the transition temperature was intergranular for annealed irons containing 0.0039% O or more, and transgranular for quenched irons containing 0.0206% O or less. This confirms the finding of Rees and Hopkins that O causes intergranular embrittlement of Fe and suggests further that, by solution treatment and quenching, the embrittling agent can be dispersed from the grain boundaries to an extent depending upon the O content. In Fe-Al alloys the mode of fracture below the transition temperature was invariably transgranular. The transition temperatures decreased somewhat as the Al content increased from 0.2% to 2.0% and then increased rapidly as the Al content increased further. In contrast with the Fe-O series, the transition temperatures and hardnesses were higher in the quenched condition than in the annealed condition. A basis for an explanation of this is the assumption that O may have sufficient solubility in Fe-Al solid solutions to have a precipitation hardening effect, occurring during quenching. (auth)

11867 NYO-7889

Princeton Univ., N. J. Project Matterhorn.
ULTRA-HIGH VACUUM TEST OF G. E. CERAMIC

SEAL MADE ACCORDING TO DWG. B1-256-A. Technical Memorandum No. 27. Herbert Sauer. [Feb. 1956]. 5p. \$1.80(ph), \$1.80(mf) OTS.

The outgassing rate of the ceramic seal was determined. A series of tests was also performed on the ceramic seal to determine the compression of the seal flanges under vacuum and the bending moment limits. (J.E.D.)

11868 ORNL-2651

Oak Ridge National Lab., Tenn.
IMPLICATIONS OF ULTRASONIC ATTENUATION TO NONDESTRUCTIVE TESTING. J. K. White, R. W. McClung, and J. W. Allen. Apr. 14, 1959. 17p. Contract W-7405-eng-26. \$3.30(ph), \$2.40(mf) OTS.

In order to relate ultrasonic inspection data to actual conditions inside a metal part, it is essential that the inspector have some knowledge of attenuation as it affects ultrasound. A brief review of the theory of ultrasonic energy attenuation is presented. Part of a study being conducted for the purpose of understanding and evaluating the large losses encountered in cast and welded steels is discussed. The equipment required and techniques employed for measuring attenuation are described. The results of these attenuation measurements are described with special reference to weld inspection. (auth)

11869 ORNL-2655

Oak Ridge National Lab., Tenn.
EDDY-CURRENT TESTING IN PRACTICE. John W. Allen. Apr. 30, 1959. 57p. Contract W-7405-eng-26. \$9.30(ph), \$3.60(mf) OTS.

The use of eddy-current testing methods is described as it applies to three major areas of effectiveness: the identification and sorting of metals according to their electrical conductivities and permeabilities; the measurement of the thickness of thin metal sections, or the thickness of cladding or shrouding of one metal on or around another; and the detection and evaluation of discontinuities and other conditions in metals relating to their quality. The basic principles of nondestructive testing with induced eddy currents are presented and discussed in detail, with particular regard to the effect of the several test parameters on the impedance of testing coils. Examples of effective eddy-current tests in use are presented, including the utilization of encircling coils for parts of cylindrical symmetry and probe coils which are applied to either plane or curved surfaces. The test systems are discussed with regard to the selection of test parameters, the attenuation of the induced eddy currents with depth, and the separation of the many variables which influence the tests. (auth)

11870 ORNL-2656

Oak Ridge National Lab., Tenn.
REVIEW OF THERMAL CONDUCTIVITY AND HEAT TRANSFER IN URANIUM DIOXIDE. V. J. Tennery. Apr. 23, 1959. 15p. Contract W-7405-eng-26. \$0.50 (OTS).

Methods of increasing the thermal conductivity of UO_2 are considered. It is suggested that the thermal conductivity of UO_2 might be increased by treating it as a potential oxide semiconductor and doping it with the proper elements. Study of the literature shows that thermal conduction by intrinsic carriers has been treated experimentally and theoretically but that the conductivities so found do not follow the Wiedemann-Franz law. Conduction by extrinsic carriers, as in a doped oxide, has not been treated theoretically. Recent measurements indicate that doping UO_2 with Y^{3+} or Nb^{5+}

increases its thermal conductivity; but the data are sparse, and the magnitude of the increase and its dependence upon impurity concentration and temperature have not been determined. Suggested experiments to test the effects of impurity addition on the thermal conductivity are described. (auth)

11871 WADC-TR-57-61(Pt. 3)

Clevite Research Center, Cleveland.

LUBRICATION OF TITANIUM. [Period covered]:

December 15, 1957 to December 15, 1958. Nicholas Fatica. Dec. 1958. 76p. Project title: METALLIC MATERIALS. Task title: TITANIUM METAL AND ALLOYS. Contract AF33(616)-3350.

The adaptation of the crossed-cylinder specimen concept in a bench tester removed most of the problems associated with specimen preparation in the investigation of various titanium-lubricant systems. It is shown that the crossed-cylinder test results correlate closely with the Shell Four-Ball test results. The crossed-cylinder tester was used to evaluate the wear resistance of cyanided and electroless-nickel plated specimens of six titanium alloys. The results show that electroless-nickel plated titanium, using conventional lubricants, is superior to the best cyanided titanium systems studied. Significant differences are shown between the wear resistance of the six nickel plated alloys in the same lubricant, and the same may be said for the various cyanided titanium alloys. The best lubricants to use with cyanided titanium alloys are the same as for the untreated alloys; Halocarbon 11-14 is generally superior to polypropylene glycol 1025, while the lubricants normally used for steel and electroless nickel are definitely inferior to these two. The comparison of wear rates for two metals having widely different moduli of elasticity has been considered, and a method of handling the problem proposed. On this basis it is shown that the wear rate of the best electroless nickel-plated titanium alloys is equivalent to 52100 steel. Carburized iron-plated titanium was also investigated to a limited extent and found to give results approaching 52100 steel. (auth)

11872 WADC-TR-58-432

Firth Sterling, Inc. American Electro Metal Div., Yonkers, N. Y.

AN INVESTIGATION OF THE MECHANICAL PROPERTIES OF CERMETS AS RELATED TO THE MICROSTRUCTURE. [Period covered]: March 1, 1957 to April 30, 1958. Ira Binder and Robert Steinitz. Aug. 1958. 94p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-5084. (AD-208148).

A summary of cermet literature, especially that pertaining to microstructure, was made. Using 60 TiC-40 Ni as the test material, seven different test groups were formulated, comprising changes in original particle size, processing procedure, and controlled binder addition. Each test group was heated in seven different fashions. Each test batch so obtained was tested for physical properties and its microstructure was investigated. The microstructures were correlated with changes in physical properties. (auth)

11873 WADC-TR-58-478(Pt. I)

Brush Beryllium Co., Cleveland.

DEVELOPMENT OF WROUGHT BERYLLIUM ALLOYS OF IMPROVED PROPERTIES. Period covered:

July 5, 1957 to July 4, 1958. John G. Klein, Leslie M. Perelman, and Wallace W. Beaver. July 5, 1958. 153p.

Project Nos. 2998 and 7351. USAF Delivery Order 33(616)-57-19. (AD-208663).

A review of the literature on alloying and other structural modifications and their effect on mechanical properties of beryllium is included. Primary consideration is given to mechanical and physical properties of QMV beryllium, both sintered and wrought, beryllium-rich alloys, and structurally modified metal; fabrication procedures are described. A discussion of background and methods used to study preferred crystallographic orientation in wrought beryllium is appended. (auth)

11874 WADC-TR-58-479

Battelle Memorial Inst., Columbus, Ohio.

RESEARCH AND DEVELOPMENT OF PROCEDURES FOR JOINING OF SIMILAR AND DISSIMILAR HEAT-RESISTING ALLOYS BY ULTRASONIC WELDING.

Period covered: July 1957 to June 1958. Normal E. Weare, John N. Antonevich, Robert E. Monroe, and David C. Martin. Sept. 17, 1958. 83p. Project title: METALLIC MATERIALS. Task title: TITANIUM METAL AND ALLOYS. Contract AF33(616)-5342. (AD-208323).

An investigation was conducted to apply ultrasonic welding to joining similar and dissimilar heat-resisting alloys and to study the fundamentals of this process. Ultrasonic spot welds were made in various combinations of heat-resisting alloys. Room temperature tension-shear and cross-tension strengths were obtained for each combination. Metallographic examinations of the heat-resistant weldments showed the presence of cracks at the edges of many of the spot welds. This cracking is probably caused by high cyclic stresses at the edge of the weld producing fatigue failures in this area. Methods of preventing such cracking can probably be determined. Efforts in the fundamental studies were aimed at studying the mechanism of bonding by ultrasonic welding. Effects of times, temperatures, and forces involved or closely related to bonding were determined although the exact mechanism was not established. Also determined were the effects of factors associated with the process and materials involved. (auth)

11875 WADC-TR-58-551

Climax Molybdenum Co. of Michigan, Detroit.

DEVELOPMENT OF HIGH STRENGTHS AND HIGH RECRYSTALLIZATION TEMPERATURES IN

MOLYBDENUM-BASE ALLOYS. M. Semchyshen, Gordon D. McArdle, and Robert Q. Barr. Sept. 23, 1958. 126p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-2861. (AD-209383). OTS.

The prime objective of this program was to prepare and study molybdenum-base alloys representing optimum compositions from the standpoint of compatibility with existing process equipment, although it was realized that these alloys were probably not optimum from the standpoint of the alloy systems. Evaluation of the soundness, machinability, hot hardness, and forgeability shed light on the practicability of preparing large castings of these alloys in the consumable electrode equipment. Some effort was also directed toward a better understanding of the variables associated with the extrusion of large bodies of molybdenum. A group of alloys was selected for study in the wrought state. The criteria were amenability to available working processes, and anticipated high recrystallization temperatures and high strength properties. (auth)

11876 WAL-401/272-3

New York Univ., New York. Coll. of Engineering. DEVELOPMENT OF TOUGH, HIGH-STRENGTH, QUATERNARY TITANIUM-BASE ALLOYS OF THE Ti-Al-V-X SYSTEM. Interim Technical Report No. 3 Harold Margolin and William F. Kirk. Aug. 1958. 93p. Project No. DA-5B93-08-021. Contract DAI-30-069-505-ORD-(P)-1506.

Seven $1\frac{1}{4}$ lb ingots and twenty-five 6 lb ingots were prepared as quaternary alloys, with the Ti-Al-V system as base. Al content varied from 4 to 8%, V content from 2 to 6%, and other alloying additions from 1 to 4%. Tensile and impact tests were carried out and on the basis of these tests alloys, Ti-6Al-4V, Ti-6Al-3V-1Cr and Ti-6Al-6V-2Sn were selected for evaluation in 25 lb ingot form. Transverse tensile and impact energy absorption data, together with impact transition temperature were obtained for each ingot. (auth)

11877 WAPD-178

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. SOME PREPARATION METHODS AND PHYSICAL CHARACTERISTICS OF UO_2 POWDERS. J. C. Clayton and S. Aronson. Dec. 1958. 47p. Contract AT-11-1-GEN-14. \$1.50(OTS).

Methods of preparation of uranium dioxide powders having a wide range of physical properties are discussed. The effects of chemical and mechanical processes, temperature of preparation, and O/U ratio on the density, surface area, porosity, crystallite size, and particle size distribution of the UO_2 are determined. The results of a microscopic study reveal that the shape and structure of the UO_2 particles depend upon their method of preparation. (auth)

11878 WAPD-PWR-PMM-2760

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.] ALTERNATE CONTROL ROD MATERIALS SILVER-BASE ALLOYS. [1958]. 11p. \$3.30(ph), \$2.40(mf) OTS.

Nickel plating of Ag-In-Cd alloy was investigated, emphasizing oxygen corrosion prevention of the alloy in high-temperature water. Results are illustrated in macro- and microphotographs. In addition, mechanical properties of the plated specimens are discussed and presented graphically. (J.R.D.)

11879 WASH-156(Del.)

Division of Research, AEC. URANIUM ALLOY NEWSLETTER NO. 9. J. Fred White, ed. Nov. 1954. Decl. with deletions Mar. 5, 1957. 42p. \$7.80(ph), \$3.30(mf) OTS.

Ames Lab. A 30 wt. % Ru-U alloy is predominantly an intermetallic compound with a small amount of eutectic present, while a 10 wt. % Ru-U alloy is very close to a eutectic composition. The solubilities of U in Ce and of Ce in U in Ce-U alloys quenched from 1137, 1170, 1200, and 1228°C were tabulated. X-ray patterns were used to determine the boundaries of the two-phase region that lies at intermediate compositions in Nb-U alloys. The tentative phase diagram of U-Zn alloys obtained from thermal, microscopic, and x-ray analyses is given. A series of Nb-U-Zr alloys, Nb-U alloys, and a Mo-U alloy were annealed at 450°C for 150 hr and 425°C for 165 hr in an effort to determine the maximum temperature at which the alloys can be annealed and still retain their corrosion resistance. Armour Research Foundation. Vickers hardness data are presented for samples of a 5.4 wt. % Mo-U alloy isothermally annealed at temperatures between 200

and 550°C after prior homogenization at 1000°C. Battelle Memorial Inst. X-ray studies to determine the crystal structure of the U-Zr Δ phase have been inconclusive so far. The phase transformation in U-Zr-Ti alloys is being studied. Chemical and radiographic examination of a series of Al-U alloys show no longitudinal segregation after melting and casting under different conditions, but transverse segregation is quite pronounced unless the alloy is cooled rapidly through the liquid-solid phase field. Attempts to cast the Cr-U eutectic as a radiation-type fuel element have not been successful. Consumable-electrode arc-melting techniques for Zr-22 wt. % U core alloy were developed. Hot rolling of the Zr-U alloy through a series of modified-square roll passes improves the surface quality of the rod. Tensile tests performed on U-1.5 at. % Si indicate that the addition of Si markedly improves the ultimate and yield strength of U without loss in ductility, but the addition of Ti to U did not improve its tensile properties. Knolls Atomic Power Lab. The kinetics of transformation and the structure of the epsilon phase in U-Zr alloys were determined. A specific etchant for U_3Si_2 appears to be 1% HF + HNO_3 (few drops. Mallinckrodt Chemical Works. Cr-U, Si-U, Ti-U, and Si-Ti-U alloys were produced by coreduction and cast. National Bureau of Standards. Microscopic and x-ray data on the U-Pt alloys indicate that the solubility of U in Pt is of the order of 7 at. % room temperature and that the system contains one intermetallic compound, U_2Pt_3 . Thermal and microscopic analyses of the Ru-U alloys indicate the U-rich portion of the system is of the simple eutectic type, and the Ru lowers the γ - β and raises the β - α transformation temperatures. National Lead Co. of Ohio. A method suitable for large scale production of homogeneous 2 wt. % Zr-U alloys was perfected. North American Aviation, Inc. The results of high temperature thermal cycling on powder compacted U alloys are tabulated. Nuclear Metals, Inc. The effect of heat treatment on the corrosion resistance of U-Si systems is being studied. The 6 wt. % Ru-U alloy melts below 900°C and is vigorously attacked by 1:1 HNO_3 . Sylvania Electric Products Inc. The effects of Mo content, compacting pressure, and sintering time on the density, hardness, and grain size of U-Mo alloys sintered at 1100°C are tabulated. Preliminary studies were made of methods of preparing a completely epsilonized U-Si alloy by powder metallurgy methods. The preparation of U alloys with Mo, Nb, or Zr by powder metallurgy methods is being investigated. Two Si-U alloys were corrosion tested. (J.S.R.)

11880 AEC-tr-3158(Rev.)

FUSION AND SELF-DIFFUSION IN SOLID METALS. K. A. Osipov. Translated by S. J. Rothman (Argonne National Lab.) from *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* No. 7, 35-40(1957). 11p. \$3.30(ph), \$2.40(mf) JCL or LC.

A method of calculating the parameters for use in the volume self-diffusion coefficient equation is presented. Assumptions are made which imply that the activated state of a group of atoms may be equated with their state at the moment before melting. The equation is in agreement with experimental data. (J.R.D.)

11881 AEC-tr-3643

A NON-ISOTHERMAL METHOD OF DETERMINING DIFFUSIONAL CHARACTERISTICS. A. A. Zhukovitski, S. N. Kryukov, and E. A. Soldatov. Translated by S. J. Rothman (Argonne National Lab.) from *Zavodskaya Lab.* 24, 1071(1958). 6p. \$1.80(ph), \$1.80(mf) JCL or LC.

A nonisothermal method of determining the diffusion characteristics of metals is described, as well as an apparatus for carrying out nonisothermal anneals. The diffusion equation is developed and applied to a demonstrative experiment in which the self-diffusion in silver was measured. Results are given, and it is pointed out that they emphasize the precision and brevity of the method. (J.R.D.)

11882 CEA-tr-A-539

OU EN EST LE PRIX DE L'URANIUM? (What Is To Be The Price Of Uranium?). E. Kruse. Translated into French from *Atomwirtschaft* 3, 168-71(1958). 15p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 8916.

11883 HW-tr-1

GRAIN REFINING OF URANIUM. J. Lehmann and H. Aubat. Translated by Liz Appleby (Hanford Atomic Products Operation) from *Rev. Mét.* 55, 1188-94(1958). 17p. \$3.30(ph), \$2.40(mf) JCL or LC.

Several methods for obtaining a refined and homogeneous grain with a slightly alloyed metal are reported. The refining of the α grain by direct quenching as well as by an isothermal transformation requires the presence of at least one impurity with a tendency to stabilize the β phase. Beta solid solution can be stabilized. Some decomposition treatments at high temperatures in the α phase give a fine grain. Direct refining by quenching has the advantage of being technically easier to realize for rods, of being more effective with the smaller alloying additions, and of decreasing the chances of fissuring. Heat treatments have been made on bars of 26 mm diameter and 100 mm or 200 mm length and have led to the same results after adaptation of the quenching conditions. (J.E.D.)

11884

INVESTIGATIONS ON THE WELDING OF OLX 52 STEEL. St. Nădasan, E. Iovitu, M. Ratiu, and I. Michels. *Acad. rep. populare, Romîne, Baza, cercetări, stiint. Timisoara, Studii cercetări, stiinte tehnice* 5, 9-32(1958) Jan.-June. (In Rumanian)

The results of investigations on the welding of OLX steel (easily welded steel alloyed with 1.6% Mn) are reported. The static mechanical characteristics, the behavior at low temperatures (-25 and -50°C), and fatigue characteristics under rotating stress and pulsed tension were determined. The results showed a superiority over similar steels produced in foreign countries. (tr-auth)

11885

EFFECT OF THE THERMAL TREATMENT UNDER NORMAL CONDITIONS ON THE INTERNAL FRICTION OF PLASTICALLY DEFORMED NICKEL. A. Cisman, B. Rothenstein, and J. Hrianca (Institutul Politehnic Timisoara, Rumania). *Acad. rep. populare, Romîne, Baza, cercetări, stiint. Timisoara, Studii cercetări, stiinte tehnice* 5, 47-55(1958) Jan.-June. (In Rumanian)

The internal friction of a nickel wire (99.2% Ni and 0.6% Mn), which was plastically deformed, was investigated up to a cross section reduction of 75%. The change of the internal friction during thermal treatment in which the temperature was increased stepwise was followed. A curve of the internal friction as a function of the temperature was obtained. It was established that the higher the temperature of the thermal treat-

ment, the lower the internal friction. After a thermal treatment at 545°C a maximum of the internal friction appeared at room temperature. The maximum was attributed to the adsorption of nitrogen. (tr-auth)

11886

X-RAY DIFFRACTION EFFECTS OF ATOMIC SIZE IN ALLOYS. II. Bernard Borie (Oak Ridge National Lab., Tenn.). *Acta Cryst.* 12, 280-2(1959) Apr.

A modification of the diffraction theory for a disordered substitutional solid solution containing atoms of different sizes gives a more accurate and simpler expression for the size effect diffuse scattering. A comparison of the theory with measurements of the diffuse scattering for Cu_3Au near $hkl = 200$ shows good agreement, even though the specimen contained some short-range order. (auth)

11887

IN NEW GAS- AND LIQUID-METAL-COOLED REACTORS, WHAT MATERIALS BEAT HIGH NUCLEAR HEAT? R. B. Norden, ed. *Chem. Eng.* 66, No. 8, 202; 204; 206(1959) Apr. 20.

A review of the advantages and disadvantages of high-melting-point metals for use in reactors at temperatures over 1470°F is presented. In addition, properties of selected high-melting-point intermetallic compounds and ceramics are tabulated. (J.R.D.)

11888

TITANIUM FOR PROCESS EQUIPMENT—NEW ALLOYS. *Chem. Eng. Progr.* 55, No. 4, 114; 120(1959) Apr.

The addition of as little as 0.1% Pd to Ti has been found to produce an alloy resistant to boiling solutions of reducing acids without impairing the metals' resistance to oxidizing acids. Mechanical and working properties are unaffected. Equal improvement in corrosion can also be affected by addition of most of the other noble metals. The choice of Pd is dictated by its price, lowest of any of the noble metals. (W.L.H.)

11889

DIFFUSION AND SOLUBILITY OF HYDROGEN IN IRON AND EXTRA SOFT STEELS. Jacques Plusquellec, Pierre Azou, and Paul Bastien. *Compt. rend.* 248, 1816-19(1959) Mar. 23. (In French)

The effect of preliminary cold working at room temperature and at the temperature of liquid air on the solubility of hydrogen in a low carbon steel was studied. Moreover, the coefficient of diffusion was determined at 20°C by using spherical samples. (tr-auth)

11890

RATE OF CONSOLIDATION OF IRON CRYSTALS. Bernard Jaoul and Daniele Gonzalez. *Compt. rend.* 248, 1932-4(1959) Apr. 1. (In French)

The consolidation curves of decarburized iron crystals under traction, prepared by critical cold working, are linear beginning with a slip of approximately 3% up to the appearance of rupture. The slopes of the curves are small and comparable to those of cubic face centered crystals in the region of easy slip. (tr-auth)

11891

STUDY OF THE TEMPERING AND RECOVERY AT ROOM TEMPERATURE OF URANIUM-CHROMIUM ALLOYS WITH A LOW CHROMIUM CONTENT. Jean Delaplace and Roland Bigot (École Nationale Supérieure de la Métallurgie et de l'Industrie des

Mines, Nancy, France). Compt. rend. **248**, 2000-2 (1959) Apr. 1. (In French)

The effect of the tempering speed and of the chromium content on the recovery, at room temperature, of the β -phase of uranium-chromium alloys tempered in the β or γ ranges was studied by isothermal dilatometry and microcinematography. (tr-auth)

11892

DILATOMETRIC STUDY BETWEEN ROOM TEMPERATURE AND 550°C OF THE ZIRCONIUM-HYDROGEN SYSTEM. Lucien Espagno, Pierre Azou, and Paul Bastien. Compt. rend. **248**, 2003-5 (1959) Apr. 1. (In French)

The use of a differential dilatometer of high sensitivity permits the direct determination of the solubility limits of hydrogen in α -zirconium and the solubility of the δ -hydride. (tr-auth)

11893

STRUCTURE OF LIQUID Au-Sn ALLOY. A. S. Lashko (Inst. of Metal Physics, Academy of Sciences, Ukrainian S.S.R.). Doklady Akad. Nauk S.S.S.R. **125**, 126-8 (1959) Mar. 1. (In Russian)

Studies were made of a liquid Au-Sn Alloy (composition 50%) which forms an intermetallic compound of the nickel arsenide type structure. The data showed that the melting of the alloy does not result in complete mixture of atoms. (R.V.J.)

11894

COMPOUNDS OF THE TRANSITION METALS WITH BERYLLIUM, SILICON, GERMANIUM, AND TIN. Ye. Ye. Cherkashin (Cherkashyn), Ye. I. Gladyshevskii (Gladyshevskiy, Gladyshevs'kyy), P. I. Kripyakevich (Kryp'yakevych). Dopovidi L'viv. Derzhav. Univ. im. I Franka No. 7, 180-3 (1957). (Translated from Referat. Zhur. Met. No. 5, 1958, p.218.)

An investigation was made of binary and ternary systems (Mn, Cr, V, Nb, Mo, and W with Be; Co + Si, Ni + Si, Co + Ge, Ni + Ge, Co + Sn, and Ni + Sn with Mn). X-ray and microstructural analyses were made, resulting in the discovery of 17 new compounds and determination of the crystal structures of 12 of these.

11895

FOUR NEW STAINLESS ALLOYS. Norman S. Mott (Copper Alloy Corp., Hillside, N. J.). Iron Age **183**, No. 16, 118-21 (1959) Apr. 16.

Four corrosion-resistant high-strength stainless steel alloys designated PH-55 alloys are presented. The composition of these alloys are: PH-55A, Cr-Ni-Si-Mo; PH-55B, Cr-Ni-Si-Cu-Mo; PH-55C, Cr-Ni-Si-Cu-Mo; and PH-55D, Cr-Ni-Si-Mo. All of these alloys can be cast and some can be rolled and forged. Physical properties of these materials are presented. (W.L.H.)

11896

TITANIUM ALLOY GETS PROTECTION FROM NOBLE METAL ADDITIONS. Iron Age **183**, No. 16, 129-30 (1959) Apr. 16.

The addition of palladium to titanium produces an alloy that is resistant to both reducing and oxidizing acids. (W.L.H.)

11897

FACTORS AFFECTING SINTERABILITY OF OXIDE POWDERS: BeO AND MgO. John F. Quirk (Battelle Memorial Inst., Columbus, Ohio). J. Am. Ceram. Soc. **42**, 178-81 (1959) Apr.

Data on the sintering of BeO and MgO were reviewed with reference to the diffusion sintering model devised by Kuczynski and Herring. Sintering rates for compacts of the dead-burned oxide powders were in agreement with the bulk diffusion model with grain-boundary sinks, but those of the active low-calcined powders were not. During isothermal sintering the low-calcined powders had very high initial shrinkages, after which the shrinkage rate was low, corresponding to a rate index of about 10. The initial high rate was ascribed to crystallization and coalescence of the material comprising individual particles. The activation energy associated with the sintering of active BeO was estimated at 249 kcal per mole. (auth)

11898

NOTE ON THE SYSTEM MAGNESIA-THORIA-HAFNIA. Stanley D. Mark, Jr. (Carborundum Co., Niagara Falls, N. Y.). J. Am. Ceram. Soc. **42**, 208 (1959) Apr.

The entire MgO-ThO₂-HfO₂ system was studied in a preliminary fashion. The system, excluding the high-magnesia and high-thoria portions, was investigated for structural relations, phases in equilibrium at 1600°C, and apparent melting points. Spectrographic analysis was made for impurities, and the apparatus for determining the melting temperatures is described. (J.E.D.)

11899

TUNGSTEN ALLOYS OF HIGH MELTING POINT.

R. Kieffer, K. Sedlatschek, and H. Braun (Metallwerk Plansee AG, Reutte, Austria). J. Less-Common Metals **1**, 19-33 (1959) Feb.

A survey of high-melting W alloys is presented. Included is a discussion of alloys of W with Ti, Zr, Hf, Cr, and Mo. In addition, alloys of W with Re are examined along with alloys with the platinum group metals and V, Nb, and Ta. Also, alloy sintering is considered. Data are presented graphically, and equipment descriptions are included. (J.R.D.)

11900

ZONE REFINING OF MOLYBDENUM. J. A. Belk (Armament Research and Development Establishment, London). J. Less-Common Metals **1**, 50-5 (1959) Feb.

The electron bombardment floating zone melting method was applied to refining Mo. Equipment design is described as well as the crystal structure and mechanical properties of the product. (J.R.D.)

11901

THE ZONE MELTING OF REFRACTORY METALS INCLUDING RHENIUM AND TUNGSTEN. G. A. Geach and F. O. Jones (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). J. Less-Common Metals **1**, 56-9 (1959) Feb.

Zone melting as a method of preparation for refractory metals is discussed. In purification of reactive refractory metals arc melting on a water-cooled hearth or electron bombardment floating zone methods are best. The arc zone melting furnace is described along with the electron bombardment floating zone furnace. Techniques of operation are described, and the single crystal growth examined. (J.R.D.)

11902

ARC-MELTING PROCESSES FOR THE REFRACTORY METALS. A. R. Moss (Armament Research and Development Establishment, Fort Halstead, Kent, Eng.). J. Less-Common Metals **1**, 60-72 (1959) Feb.

A method for arc melting and casting refractory

metals in water-cooled copper molds is presented. By using inert atmospheres or vacuum, the method may be adapted for preparation of highly reactive metals. The arc-melting processes described are suitable for refractory metals as well as Ti and high-melting-point heat-resisting alloys. (J.R.D.)

11903

TECHNIQUES USED IN ALLOY INVESTIGATIONS AT TEMPERATURES ABOVE 1200°C. J. R. Murray and G. K. Williamson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals **1**, 73-6(1959) Feb.

Factors in investigation of U and Th alloys at elevated temperatures are examined. Most attention is given to techniques of thermal analysis and problems related to the reactivity of these materials at high temperature. Experimental results are presented graphically. (J.R.D.)

11904

ARC FURNACE AND ELECTRON BOMBARDMENT TECHNIQUES USED IN STUDIES OF THE REFRACTORY METALS. F. O. Jones, A. G. Knapton, and J. Savill (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). J. Less-Common Metals **1**, 80-4(1959) Feb.

Alloy preparation techniques are examined. Applications of the arc furnace are described as well as those of electron bombardment heating with emphasis on refractory and highly reactive metals. (J.R.D.)

11905

CORROSION BEHAVIOUR OF RESISTANT METALS IN URANYL SULPHATE SOLUTION. N. Dekleva and I. Perman. "J. Stefan" Inst. Repts. (Ljubljana) **4**, 157-8(1957).

Five resistant metals, which might eventually be considered as suitable for protective coatings, e.g., Ru, Ti, Pt, Ta, and Au, were chosen and their resistance tested against acid uranyl sulfate solution at 100°C and at normal pressure as well as at 200°C and at a pressure of 16 atmospheres. Among all five metals tantalum and ruthenium turned out to be the most resistant. Titanium only becomes resistant when a sufficiently strong protective film of titanium oxide is produced, which protects the titanium metal against further dissolving. Gold and platinum cannot be used as they are constantly slowly dissolving. The time dependence of the rate of dissolution for all the metals investigated is also given. (auth)

11906

GAMMA RADIOGRAPHY WITH IRIIDIUM¹⁹². ADVANCES IN THE NON-DESTRUCTIVE TESTING OF CASTINGS AND WELDED STRUCTURES. R. A. Mintern and J. C. Chaston. Platinum Metals Rev. **3**, 12-16(1959) Jan.

Nondestructive testing of welded steel with Ir¹⁹² sources is discussed. The radiographic technique and exposure charts for steel are included. (W.L.H.)

11907

JOINING REFRACTORY METALS. (To Sylvania Electric Products Inc.). U. S. Patent 2,844,868. Platinum Metals Rev. **3**, 35(1959) Jan.

Cathodes are made by coating a cylindrical metal base with a thin layer of Ru powder, wrapping a Mo mesh round the coated base and heating the assembly to 1150 to 1400°C to form a preliminary bond between the base and the mesh and finally heating the assembly to 1900 to 2100°C.

11908

MAKING USE OF THE ACHIEVEMENTS OF NUCLEAR PHYSICS IN METALLURGY. P. L. Gruzin. Primenenie Radioaktiv. Izotopov v Chernoi Met. 19-31(1957). (Translated from Referat. Zhur. Met. No. 4, 1958, p.1.)

The use of isotopes and nuclear radiations in metallurgy, instrument and machine manufacture, and the study and control of metallurgical processes is described.

11909

DISCUSSIONS (AT THE CONFERENCE ON UTILIZATION OF RADIOACTIVE ISOTOPES IN FERROUS METALLURGY). Primenenie Radioaktiv. Izotopov v Chernoi Met. 75-82(1957). (Translated from Referat. Zhur. Met. No. 4, 1958, p.49.)

The remarks of M. K. Skul'skiy, V. I. Pevtsov, V. N. Afanas'yev, Ye. I. Rabinovich, and P. L. Gruzin on blast-furnace operation, the study of the durability of hearth bottom masonry by means of radioactive isotopes, equipment, methods of emplacing isotopes and tracers for the investigation of hearth bottom erosion, standards for the contamination of products by isotopes, and employment of neutron radiation to determine rate of motion of charge components in the blast furnace are reported.

11910

STUDIES ON URANIUM-IRON ALLOYS. T. Gelger and C. Fizzotti. Sulzer Tech. Rev. (Switz.) **40**, No. 3, 23-30(1958).

When metallic uranium is employed as a fuel in nuclear reactors, undesirable deformations and surface changes occur under irradiation and in the fluctuating temperature field. Some possibilities of improving the stability of uranium are mentioned, and observations of the behavior of uranium-iron alloys are described. The effects of alloying and of heat treatment are investigated with the aid of thermo-cycling tests. The latter are no substitute for irradiation tests, but they enable qualitative comparisons to be made between samples which have undergone different treatments. Interesting observations are made in respect of the transformation behavior of uranium with small iron contents, in that stabilization of the β -phase by quenching is possible. The undercooled β -phase may be transformed isothermally into the α -phase by a martensitic transformation. (auth)

11911

THE THERMODYNAMICS OF THE DECARBURISATION OF MOLTEN URANIUM. R. H. Weisser. Sulzer Tech. Rev. (Switz.) **40**, No. 3, 31-2(1958).

Three possibilities for removing carbon from molten U are briefly summarized, and it is shown that they cannot be applied in practice. (auth)

11912

COMPARISON OF THE PHYSICAL PROPERTIES OF A FEW TYPES OF FUEL ELEMENTS. P. Lehmann, R. W. Meier, and J. -P. Schneeberger. Sulzer Tech. Rev. (Switz.) **40**, No. 3, 33-40(1958).

In connection with a general comparative study of D₂O-moderated pressure-vessel and pressurized-tube reactors, the material buckling of two structurally different composite fuel elements of natural uranium was investigated. These were a rod cluster element in the case of the pressure vessel and an internally cooled tube cluster element in the case of the pressurized-tube type. The methods of calculation are based on new Canadian, American and French theories which have

been extended to permit their application to composite elements. The number of free geometrical variables was limited by thermal conditions and the specific load (watts per gram of fuel) was introduced as a parameter. Data on material buckling as a function of the moderator-to-uranium ratio are given both for the nominal output (steady temperatures and Xe-Sm poisoning) and for zero output (temperature 20°C, no poisoning). (auth)

11913

PREPARATION OF TWO LITHIUM-ARSENIC COMPOUNDS. R. E. Tate and F. W. Schonfeld (Los Alamos Scientific Lab., N. Mex.). Trans. Met. Soc. AIME **215**, 296-8(1959) Apr.

The preparation and properties of the two compounds LiAs and Li_3As are described. (J.E.D.)

11914

THE LANTHANUM-CARBON SYSTEM. F. H. Spedding and A. H. Daane (Iowa State Coll., Ames) and K. Gscheidner, Jr. (Los Alamos Scientific Lab., N. Mex.). Trans. Met. Soc. AIME **215**, 192-9(1959) Apr.

From thermal, metallographic, x-ray, dilatometric, and electrical resistance data a phase diagram is proposed for the La-C system. Two compounds are formed, body-centered-cubic La_2C_3 having a large range of solid solubility, and body-centered-tetragonal LaC_2 . The former melts incongruently at 1415°C, and at 25°C it has an electrical resistivity about two and one-half times that of pure lanthanum. The latter melts congruently at 2356°C and at room temperature has an electrical resistivity about equal to that of pure lanthanum. The addition of carbon to La lowers the melting point of La about 115°C, raises the higher (β - γ) transformation about 10°C and appears to have no effect on the lower (α - β) transformation. The addition of carbon appears to lower the oxygen content in the metal and improve the machinability; however, the tendency to oxidize is increased. Two eutectics are formed in the system. The first occurs at 2.2% C and melts at 806°C, while the second occurs between LaC_2 and C with a melting point of 2271°C. (auth)

11915

THE ANTIMONY-URANIUM ALLOY SYSTEM. B. J. Beaudry and A. H. Daane (Iowa State College, Ames). Trans. Met. Soc. AIME **215**, 199-203(1959) Apr.

The uranium-antimony system has been investigated by metallographic, thermal, and x-ray methods. There are four intermediate phases present: USb_2 and U_3Sb_4 which undergo peritectic decomposition at 1355 and 1695°C, respectively, and USb and U_4Sb_3 which melt congruently at 1850 and 1800°C, respectively. There is a eutectic between U_4Sb_3 and USb which melts at 1770°C. USb_2 , U_3Sb_4 , and USb are line compounds while U_4Sb_3 has a solubility range of approximately 1.5 at. % at 1770°C. Single crystal studies of the compound U_4Sb_3 show it to have a hexagonal unit cell with $a_0 = 9.268\text{\AA}$ and $c_0 = 6.201\text{\AA}$. The solubility of uranium in liquid antimony increases from 0.1 at. % at 650°C to 1.5 at. % at 900°C. The solubility of antimony in α , β , and γ uranium is approximately 0.02, 0.1, and 0.05 at. %, respectively. (auth)

11916

THE FREE-ENERGY CHANGES ATTENDING THE MARTENSITIC TRANSFORMATION IN THE IRON-CHROMIUM AND IRON-CHROMIUM-NICKEL SYSTEMS. Larry Kaufman (Manufacturing Labs. Inc.,

Cambridge, Mass.). Trans. Met. Soc. AIME **215**, 218-23(1959) Apr.

An equation is derived relating $\Delta F^{\alpha' \rightarrow \gamma}$, the difference in free energy between austenite and martensite, to temperature and composition in the iron-chromium and iron-chromium-nickel systems. This equation is used to calculate $\Delta F^{\alpha' \rightarrow \gamma}$ at M_s for low-carbon stainless steels. A method for utilizing the energetic equations to calculate M_s in stainless steels is suggested. In addition, an explanation is given for the anomalous effect of chromium in forming a γ loop concurrent with the lowering of M_s in iron-base alloys. (auth)

11917

HEAT TREATMENT, TRANSFORMATION REACTIONS, AND MECHANICAL PROPERTIES OF SOME HIGH-STRENGTH ZIRCONIUM-BASE ALLOYS. H. A. Robinson (Cities Service, Inc., Lake Charles, La.); J. R. Dolg and P. D. Frost (Battelle Memorial Inst., Columbus, Ohio) and M. W. Mote (Denver Research Inst., Colo.). Trans. Met. Soc. AIME **215**, 237-45(1959) Apr.

The mechanism of hardening in heat-treatable zirconium alloys was found to be analogous to that for titanium alloys. Zirconium containing a relatively large addition of a β -stabilizing element such as molybdenum or niobium can be hardened by the following transformation: $\beta_{\text{lean}} \rightarrow \omega + \beta_{\text{enriched}} \rightarrow \alpha + \beta_{\text{enriched}}$. Lean alloys, having insufficient alloy content to retain β at room temperature, are hardened by the following transformation: $\beta_{\text{lean}} \rightarrow \alpha' \rightarrow \alpha + \beta_{\text{enriched}}$. Application of these findings in Zr-Mo-Sn and Zr-Nb-Sn alloys produced strengths as high as 190,000 psi with reasonable ductility. (auth)

11918

THE IMMISCIBILITY LIMITS OF URANIUM WITH THE RARE-EARTH METALS. J. F. Haefling and A. H. Daane (Iowa State Coll., Ames). Trans. Met. Soc. AIME **215**, 336-8(1959) Apr.

The limits of miscibility in some of the uranium-rare earth alloy systems have been determined in the temperature range 1000 to 1250°C. The solubilities of lanthanum and cerium in uranium are greater than those of the remaining rare earths by a factor of more than two. The solubility of uranium is greater in cerium, praseodymium, and neodymium than in the other rare earth metals studied. The values found in this study are in qualitative agreement with those which might be expected if the solubility rules of Hildebrand and Scott are applicable. (auth)

11919

AN INVESTIGATION OF THE PHASE DIAGRAM OF THE QUATERNARY SYSTEM CRYOLITE-ALUMINUM FLUORIDE-CALCIUM FLUORIDE-ALUMINA. G. A. Abramov, A. A. Kostyukov, and L. B. Kulakov. Trudy Leningrad. Politekh. Inst. No. 188, 45-57(1957). (Translated from Referat. Zhur. Met. No. 6, 1958, p.35.)

Methods of thermal and optical analysis are used to study the phase diagram of the $5\text{NaF} \cdot 3\text{AlF}_3 - \text{CaF}_2 - \text{Al}_2\text{O}_3$ section of the quaternary system $\text{Na}_3\text{AlF}_6 - \text{AlF}_3 - \text{CaF}_2 - \text{Al}_2\text{O}_3$ for the purpose of arriving at a better substantiated approach to the selection of the optimum composition of the electrolyte of Al baths, and in order to develop a crystal optical method of determining the molar ratio $\text{NaF}:\text{AlF}_3$ in baths containing CaF_2 and a crystal optical method of determining the CaF_2 content of Al bath electrolytes. The following is established: (1) the surface of the liquidus

of the $5\text{NaF} \cdot 3\text{AlF}_3 - \text{CaF}_2 - \text{Al}_2\text{O}_3$ section is formed by 3 fields—cryolite, CaF_2 , and Al_2O_3 ; (2) the $5\text{NaF} - \text{AlF}_3 - \text{CaF}_2 - \text{Al}_2\text{O}_3$ section divides the tetrahedron of the quaternary system into 2 spaces. The alloys in the space adjacent to the cryolite corner of the tetrahedron, limited by the $5\text{NaF} \cdot 3\text{AlF}_3 - \text{CaF}_2 - \text{Al}_2\text{O}_3$ plane, undergo final solidification at the quaternary peritectic point at 685°C . The alloys lying in the $5\text{NaF} \cdot 3\text{AlF}_3 - \text{Al}_2\text{O}_3 - \text{CaF}_2 \cdot \text{AlF}_3$ space undergo final solidification at the quaternary eutectic point at 665° . The composition for the quaternary transition point is found.

11920

AN INVESTIGATION OF THE PHASE DIAGRAM OF THE TERNARY SYSTEM SODIUM FLUORIDE—ALUMINUM FLUORIDE—MAGNESIUM FLUORIDE.

A. A. Kostyukov and A. B. Karpov. *Trudy Leningrad. Politekh. Inst.* No. 188, 58–66(1957). (Translated from *Referat. Zhur. Met.* No. 6, 1958, p.35)

The methods of thermal analysis and microstructural analysis are used to study the following binary systems: (1) $\text{NaF}-\text{MgF}_2$; (2) $\text{MgF}_2-\text{AlF}_3$; (3) $\text{Na}_3\text{AlF}_6-\text{MgF}_2$; (4) $\text{Na}_3\text{AlF}_6-\text{NaMgF}_3$; and (5) $\text{NaMgF}_3-\text{AlF}_3$. Systems (1) and (2) are binary accessory systems, while (3), (4), and (5) are sections of the ternary system $\text{NaF}-\text{AlF}_3-\text{MgF}_2$, a study of which is necessary to clarify the effectiveness of addition of MgF_2 to the electrolyte during Al refining to reduce the m.p. of the electrolyte, to develop crystal-optical methods of monitoring the composition of the electrolyte in Al baths when MgF_2 is used as an addition, and to clarify the chemical reaction among the starting components. It is shown that (1) $\text{Na}_3\text{AlF}_6-\text{MgF}_2$ and $\text{NaMgF}_3-\text{AlF}_3$ are not binary systems. The phase diagrams of these systems reveal branches of primary crystallization of the products of exchange between the starting components; (2) the ternary system $\text{NaF}-\text{AlF}_3-\text{MgF}_2$ is divided by the $\text{Na}_3\text{AlF}_6-\text{NaMgF}_3$ secant into 2 secondary systems: the ternary system $\text{NaF}-\text{Na}_3\text{AlF}_6-\text{NaMgF}_3$ and the ternary reciprocal salt-pair system $\text{Na}_3\text{AlF}_6 + 3\text{MgF}_2 \rightleftharpoons 3\text{NaMgF}_3 + \text{AlF}_3$; (3) the metastable diagonal sections $\text{Na}_3\text{AlF}_6-\text{MgF}_2$ and $\text{NaMgF}_3-\text{AlF}_3$ of this reciprocal salt-pair system testify to the state of equilibrium of the exchange reactions $\text{Na}_3\text{AlF}_6 + 3\text{MgF}_2 \rightleftharpoons 3\text{NaMgF}_3 + \text{AlF}_3$ in the melt, belonging to the class of reversible reciprocal salt-pair systems.

11921

ON THE APPLICATION OF ALUMINUM PHOSPHATES AS BINDERS FOR HIGHLY REFRACTORY COATINGS ON METAL.

G. N. Duderov and V. I. Ryzhikov. *Trudy Moskov. Khim. Tekhnol. Inst. im. D.I. Mendeleeva* No. 24, 190–8(1957). (Translated from *Referat. Zhur. Met.* No. 6, 1958, p.258.)

A procedure for applying anticorrosive coatings on metals using aluminum phosphates as a binder and corundum as a filler is described. A maximum strength of cohesion between the metal and the coating equal to 92.6 kg/cm^2 was obtained by using a binder with a ratio 1:2.06 between $\text{Al}(\text{OH})_3$ and H_3PO_4 , and a moisture content of 55 to 59%. (W.D.M.)

11922

A RAPID METHOD OF DETERMINING THE ISOTOPES OF RADIUM IN ROCKS AND MINERALS. P. I. Chaykin and K. K. Gumbar. *Vsesoyuz. Nauch. Issledovatel. Geol. Inst. Inform. Sbornik* No. 3, 131–3(1956). (Translated from *Referat. Zhur. Geol.* No. 5, 1957, p.94.)

A rapid method for the determination of radium and thorium isotopes in rocks and minerals is proposed.

To a small sample are added BaCl_2 , HF, and phosphoric acid. After heating, the fused mass is leached with acetic acid, and the filtrate is bubbled, the Ra and Th being determined by the emanation. (W.D.M.)

11923

STUDIES ON THE MECHANISM OF ELECTROCHEMICAL CORROSION OF TITANIUM. I. THE EFFECT OF HALIDE IONS ON THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF TITANIUM IN SULFURIC ACID. N. D. Tomashov and R. M. Al'tovskii (Inst. of Physical Chemistry, Academy of Sciences of SSSR, Moscow). *Zhur. Fiz. Khim.* 33, 610–16(1959) Mar. (In Russian)

The corrosion behavior of titanium is determined by the presence of a protective oxide film on its surface. The halide ions Cl^- and Br^- in sulfuric acid in an atmosphere of air and of hydrogen have a double effect on the corrosion of titanium activating it in dilute acid solutions and retarding the corrosion in more concentrated solutions. In all sulfuric acid solutions studied I^- ions passivate titanium in air, whereas in hydrogen this is true only for concentrated solutions. The retardation of titanium corrosion by halide ions may be explained by their forming adsorbed or phase protective films on the titanium surface. The dissolution of titanium in sulfuric acid obeys the laws of electrochemical kinetics. (auth)

11924

A STUDY OF THE RESISTANCE TO CORROSION OF SOLID METALLIC SOLUTIONS WITH THE AID OF THE RADIOTRACER METHOD. THE SYSTEM $\text{In}-\text{Pb}$. N. N. Gratsianskiĭ and N. A. Bogacheva (Inst. of General and Inorganic Chemistry, Kiev). *Zhur. Fiz. Khim.* 33, 677–82(1959) Mar. (In Russian)

Corrosion studies were carried out in 1% H_2SO_4 solution at room temperature. The depth of the micropores in the surface of the alloys before and after corrosion was determined. These were: for In $\sim 3\mu$ before corrosion, increasing to 7μ after corrosion; for Pb $\sim 2\mu$ before corrosion and 4μ after corrosion; for nonresistant In–Pb alloys $\sim 1\mu$ before corrosion and $\sim 3\mu$ after corrosion; and for resistant In–Pb alloys $\sim 1\mu$ before corrosion and $\sim 2.5\mu$ after corrosion. On submersion for 10 minutes in a nonaggressive solution isotopic exchange takes place only between the surface of the metals and alloys and their ions in solution. In the process of corrosion changes in the composition of the surface layer of In–Pb alloys were found after 6 days, there being a sharp fall in the indium content. On the establishment of steady state in the corrosion process, after 12 days, the layer formed on the surface of In–Pb alloys for a depth up to 2μ consists of lead. From 2 to 9μ , there is a gradual increase in the indium content, following which the composition becomes that of the alloy proper. It may thus be inferred that the depth of the surface layer to which radioactive isotopes penetrate corresponds to that of the corrosion layer formed. In nonaggressive media where no corrosive destruction of the alloy surface is observed, there is no diffusion of radioactive isotopes in the surface layer. (auth)

11925

VACANCIES AND OTHER POINT DEFECTS IN METALS AND ALLOYS. A Symposium Organized by the Institute of Metals and Held at the Atomic Energy Research Establishment, Harwell, Berks, on 10 December, 1957. Institute of Metals Monograph and Report Series No. 23. London, The Institute of Metals, 1958. 240p.

An account is given of the mechanical effects of vacancies and other point defects introduced into metals and alloys by irradiation, quenching, deviations from stoichiometry, and cold work. The hardening and embrittlement of metals by nuclear radiation and aspects of intermetallic compound strength at low temperatures are considered, as well as fatigue deformation in metals and alloys and aging processes in cold-worked alloys. The discussions and data are primarily concerned with temperatures below the range of self-diffusion. (J.R.D.)

11926

VACUUM METALLURGY. Materials Technology Series. Rointan F. Bunshah, ed. New York, Reinhold Publishing Corp., 1958. 484p.

The first part of this volume discusses vacuum equipment, including pumping systems, gages, leak detection, and trouble shooting. Part two describes the kinetics of vacuum metallurgy and kinetics in vacuum induction and vacuum arc melting. Part three presents various arcs and arc-melting processes. Part four describes induction melting of ingot products and cast shapes. The fifth part presents electron bombardment melting techniques. Part six discusses degassing in the liquid and solid states. Part seven is devoted to the distillation of metals. The last two parts discuss the metallurgical application of vacuum processing and analytical techniques. (W.L.H.)

11927

PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS. VOLUME XVI, NUMBER 1. C. V. Mahlmann and W. M. Murray, eds. Cambridge, Mass., Society for Experimental Stress Analysis, 1958. 208p.

A method is presented for determining the Hencky-von Mises effective (or uniaxial equivalent) stress in terms of directly measurable photoelastic quantities. Spectrum fatigue test results are compared with predictions obtained through results from tests at constant stress levels. Tests run to determine the causes of destructive vibration of a 700-horsepower induced draft fan in a motor-magnetic clutch-fan installation are presented. The concept of the shock spectrum has been extended so as to account for multiple applications of the load where fatigue is of importance. An installation for testing large structures or sub-assemblies for endurance under either static or dynamic loading has been developed and put into operation. Some of the devices and procedures developed to apply the same kind of loadings to a simulated solid propeller blade as were assumed in the mathematical derivation are described. A photoelastic analysis is described for the dynamic stress distribution surrounding a running crack started from one edge of a plate in tension. The performance of foil-type high-temperature strain gages up to 700°F is reported. The results of analytical and experimental studies to determine the short time, top-to-bottom compressive load-carrying capacity of commercial corrugated fiberboard containers are presented. The resistance network solutions of some structural problems in deflection and stability are reported. Stress concentration produced in perforated strips under tension is presented. New waterproofing techniques and materials for protection of strain gages and associated wiring are described. The effect of hydrostatic pressure on SR-4 strain gages is reported. An impact testing machine for plastics and rubber-like materials is described.

Stress and strength studies are reported on turbine blade attachments. An approximate method is presented for determining the response of an accelerometer. Simple cylindrical heads for testing columns approximately in the pin-ended condition are described. A method is developed for the determination of tangential residual stress distribution in curved beams of rectangular cross section. (W.L.H.)

11928

PROGRESS IN METAL PHYSICS. [VOLUME] 7. Bruce Chalmers and R. King, eds. New York, Pergamon Press, 1958. 413p.

The first section of this volume discussed equilibrium, diffusion, and imperfections in semiconductors. The second section is devoted to the physical metallurgy of titanium alloys. In the third section the thermodynamics and kinetics of martensitic transformations are reported. In the fourth section the stored energy of cold work is presented. The last section discusses the properties of metals at low temperatures. (W.L.H.)

11929

THE PHYSICAL METALLURGY OF MAGNESIUM AND ITS ALLOYS. G. V. Raynor. New York, Pergamon Press, 1959. 536p.

The physical and chemical properties of magnesium are reported. The electronic structure, lattice spacings, alloying behavior, and intermediate phases of magnesium alloys are presented. Alloys of magnesium with various metals are discussed. The systems formed by magnesium with gaseous elements or compounds are reported. The effect of alloying on the mechanical properties of magnesium is discussed. (W.L.H.)

11930

IMPROVEMENTS IN OR RELATING TO HEAT TREATMENT OF URANIUM. Joseph Stephenson and Leslie Mark Wyatt (to United Kingdom Atomic Energy Authority). British Patent 812,123. Apr. 22, 1959.

A heat treatment for U is proposed which reduces grain size of castings. It consists of heating in a salt bath to 735°C for 13 min followed by a quench in CaCl₂ brine at -30°C. Average grain size of macro 0.25 mm is obtained. (T.R.H.)

PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

11931 AECU-4009

Los Alamos Scientific Lab., N. Mex.

ABSTRACT BIBLIOGRAPHY ON LINEAR ACCELERATORS (DECEMBER 1928 to DECEMBER 1957); (EXCLUDING VAN de GRAAFF GENERATORS AND COCKCROFT-WALTON ACCELERATORS). Carol Malmberg, comp. Mar. 21, 1958. 84p. Contract [W-7405-eng-36]. (D-BIB-22). \$7.80(ph), \$3.30(mf) OTS.

See also AECU-4010 (D-BIB-23) and AECU-4012 (D-BIB-27).

A bibliography on linear accelerators covering the period December 1928 to December 1957 is presented. References to Van de Graaff generators and Cockcroft-Walton accelerators are not included. (J.E.D.)

11932 AECU-4010

Los Alamos Scientific Lab., N. Mex.

ABSTRACT BIBLIOGRAPHY ON TRAVELING WAVE LINEAR ACCELERATORS (JANUARY 1946 TO DECEMBER 1957). Carol Malmberg, comp. Apr. 21, 1958. 29p. Contract [W-7405-eng-36]. (D-BIB-23).

See also AECU-4009 (D-BIB-22) and AECU-4012 (D-BIB-27).

An abstract bibliography on traveling wave linear accelerators from Jan. 1946 to Dec. 1957 is presented. *Science Abstracts A and B*, Jan. 1940 to Dec. 1957, and *Progress in Physics*, volume XIII, 1948-1949, pages 103/132, were consulted. (J.R.D.)

11933 CERN-59-11

European Organization for Nuclear Research, Geneva. BEAM INTENSITY LIMITATION IN NEUTRALIZED SPACE CHARGE BETATONS. Ch. Maisonnier and D. Finkelstein. Mar. 12, 1959. 15p.

A criterion is derived for the maximum beam intensity admissible into a betatron. The calculations are non-relativistic and apply to the crucial regime near injection. Beam behavior at higher energies is considered, and ways of avoiding this intensity limitation in future machines are discussed. (W.D.M.)

11934 CF-59-1-6

Oak Ridge National Lab., Tenn.

MINUTES OF THE CYCLOTRON SHIELDING MEETING HELD AT THE OAK RIDGE NATIONAL LABORATORY ON DECEMBER 18, 1958. Jan. 8, 1959. 9p. Contract [W-7405-eng-26]. \$1.80(ph), \$1.80(mf) OTS.

Brief discussions of calculational approaches to cyclotron shield design are given. (D.E.B.)

11935 HW-55085

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

NEUTRON MEASUREMENTS II: OPERATING POINTS FOR OBTAINING NEUTRONS FROM THE HAPO POSITIVE ION ACCELERATOR. J. DePangher. Feb. 3, 1958. 29p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

Data are presented to assist experimenters in making efficient use of the positive ion accelerator in calibrating neutron dosimeters. (auth)

11936 MURA-445

Midwestern Universities Research Assn., Madison, Wis. CONCERNING RESONANT BEAM KNOCK-OUT FROM AN A-G SYNCHROTRON. L. Jackson Laslett and Charles L. Hammer. Feb. 2, 1959. 78p. Contract AT(11-1)-384. \$2.00(OTS).

The efficacy of various types of field-index perturbations in effecting an instability potentially helpful for beam utilization is examined analytically for an alternating-gradient particle accelerator and the results illustrated by computational examples. The perturbations of interest open up a stop-band, at the frequency ν_x , within which the solution to the equations for the radial betatron oscillations soon become dominated by a solution of exponentially-increasing amplitude. A field-index perturbation containing circular functions can open up such a stop-band. The azimuthal dependence of the perturbation can also serve to influence the form of the unstable solution. (auth)

11937

THE BETATRON. Stefan Haltrich and Iulian Leibovici. *Automat. si Electron.* **1**, 119-29(1957). (Translated from *Referat. Zhur. Fiz.* No. 8, 1958, Abstract No. 17321.)

The role of the betatron is indicated for research and practical applications. The operating principles are explained. The stability of motion of the electrons, the acceleration process, and the type of construction used are discussed.

11938

FINAL CONSTRUCTION AND MEASURING RESULTS OF THE HIGH FREQUENCY ION SOURCE FOR THE VAN DE GRAAFF ACCELERATOR. E. Cilenšek, F. Cvelbar, and V. Ramšak. "J. Stefan" Inst. Repts. (Ljubljana) **4**, 117-22(1957). (In German)

In an ion source with supplementary instruments for the measurement and analysis of the ionic beam, the intensity of the ion beam and the proton constituent was investigated as a function of the coupling between oscillator and discharge tube and of the size and purity of the metallic surface in the discharge tube with admixtures in the hydrogen. (tr-auth)

11939

HIGH ENERGY PARTICLE ACCELERATORS. Helmut Steinwedel (Institut für theoretische Physik, Göttingen, Ger.). *Naturwissenschaften* **46**, 163-7(1959). (In German)

A brief survey is presented on particle accelerators. The linear accelerator, circular accelerator, cyclotron, betatron, stabilization of the particle orbit, and new construction proposals are considered. (J.S.R.)

11940

THE 7 Gev PROTON SYNCHROTRON: THEORETICAL ASPECTS. T. G. Pickavance (Rutherford High Energy Lab., Harwell, Berks, Eng.). *Nuclear Eng.* **4**, 151-6(1959) Apr.

The theoretical aspects of the 7-Bev proton synchrotron under construction at Rutherford Radiation Laboratory are discussed. The machine is a constant-gradient proton synchrotron with a magnet ring 150 ft in diameter containing 7000 tons of special magnetic steel. The proton energy at injection is 15 Mev. The machine output is 25 to 30 pulses per minute with 10^{12} protons per pulse. (W.D.M.)

11941

ON A 200 kev RADIOFREQUENCY DEUTERON ACCELERATOR OF THE COCKCROFT AND WALTON TYPE. F. Demaninis and G. Poiani (Univ. of Trieste and Istituto Nazionale di Fisica Nucleare, Trieste). *Nuovo cimento* (10) **11**, 593-9(1959) Feb. 16.

A description is given of a 200-kev deuteron accelerator for the production of neutrons through d-d and d-t reactions. It is pointed out that its principal characteristic is that high tension is obtained by means of a radiofrequency voltage multiplying circuit. (auth)

11942

THE BEVATRON. Edward J. Lofgren (Univ. of California, Berkeley). *Proc. Natl. Acad. Sci. U. S.* **45**, 451-6(1959) Apr.

The 6-Bev Bevatron of the University of California is described and its operation explained. (A.C.)

PHYSICS AND MATHEMATICS

General

11943 AEFI-62

Aktiebolaget Atomenergi, Stockholm. RESONANSABSORPTION VID ALLMÄNT ROMBOID-

ISKIT GITTER. (Resonance Absorption in Normally Rhomboidal Lattices.) I. Carlvik. Mar. 29, 1957. 10p.

The neutron flux function $\phi(x) = (V_T/4\pi\bar{r}) \Sigma' e^{-(\phi^2 mn/4\bar{r})}$ (where V_T is the cell cross section, \bar{r} is the average resonance age of neutrons in the lattice, and d_{mn}^2 is the distance between rods) is calculated for various values of x , a dimensionless variable, for square and triangular lattices. The function $\phi(x)$ is particularized for D_2O moderated cells as $B(b\sqrt{V_M/V_T})$, where V_M is the moderator cross section. The values for square and triangular lattices are calculated. (J.S.R.)

11944 AERE-G/M-152

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

EPICYCLIC ORBITS OF CHARGED PARTICLES. E. R. Harrison. May 28, 1953. 17p.

In a constant magnetic field and a central force field of $F = \pm \beta r$, charged particles have epicyclic orbits. These orbits are more varied than those of the simple cycloid, which occur when F is constant. The orbits are of two kinds: the direct epicyclics and the retrograde epicyclics, corresponding, respectively to orbits occurring in central repulsion and central attraction force fields. These orbits are further subdivided and briefly studied, and it is shown that in an attraction force field certain orbits occur which are paramagnetic. The epicyclics have angular rates of flow of charge about the center of force of $\Omega = -\omega \pm (\omega^2 - F/mr)^{1/2}$, which are termed the magnetodynamic precessions. (auth)

11945 AERE-G/R-767

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

A METHOD OF MEASURING THE Q-FACTOR OF AN ELECTROMAGNETIC MODE IN A RESONATOR, EMPLOYING A FREQUENCY MODULATED KLYSTRON. J. H. Adlam, F. H. James, and L. B. Mullett. Aug. 1951. Changed from OFFICIAL USE ONLY Mar. 17, 1959. 13p.

A method was developed to measure the Q-factors of the modes in resonators partly filled with ceramic dielectric material. Measurements have so far been confined to titania ceramic and magnesium titanate ceramic. Resonators filled with titania ceramic give rise to modes with a Q-factor between 2,000 and 3,000, which can be measured to about 1 part in 30. Resonators filled with magnesium titanate ceramic give rise to modes with a Q-factor of about 10,000 which can be measured to about 1 part in 100. (auth)

11946 AERE-HP/GEN-5

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

ABSORPTION IN WATER OF THE γ RADIATION FROM IRRADIATED URANIUM SLUGS. E. M. Flew and B. T. James. Nov. 29, 1955. 4p.

Graphs are presented of the fraction of gamma radiation transmitted through water thicknesses up to 5.5 ft. Measurements were taken at water level and at four inches above water level. (W.D.M.)

11947 APEX-472

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

ON AN INTEGRAL EQUATION OCCURRING IN THE STUDY OF A FOLDED FLOW. J. F. Heyda. Jan. 22, 1959. 13p. (XDC-59-1-257). \$3.30(ph), \$2.40(mf) OTS.

An incompressible inviscid fluid, in a steady, two-dimensional, non-potential flow, upon crossing a linear

boundary turns sharply so that the resultant flow is roughly normal to the inlet flow. An integral equation relating the shape of the outermost streamline, the inlet flow rate, the lateral pressure variation, and the initial streamline slope is set up, and solutions for a given one of these four quantities in terms of the other three are considered. Where possible the solutions are obtained exactly by an analytical procedure; otherwise, iterative formulations are derived for use on high speed computing equipment. (auth)

11948 APEX-476

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

A METHOD FOR SIMULATING REACTOR KINETIC EQUATIONS OVER MANY DECADES. J. K. Baker. Aug. 1958. 10p. Contracts AF33(600)-38062 and AT (11-1)-171. \$0.50(OTS).

A method is described that may be used to solve reactor kinetic equations over as many decades as needed. Previous analog computer methods were limited in range; with the new method a reactor simulator can be operated beyond a range of 100 to 1 in power. (auth)

11949 ARGMA-TR-1C3OR

Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala.

GAMMA-GAMMA COINCIDENCE MEASUREMENTS OF Ba^{133} . W. L. Croft and J. R. Haskins. Jan. 31, 1959. 19p. Project No. TB2-0001.

The gamma-ray spectrum and γ - γ coincidence of Ba^{133} are discussed, a decay scheme consistent with the data is proposed, results are compared with literature, and suggestions are made for further investigation. (auth)

11950 CERN-59-9

European Organization for Nuclear Research, Geneva. NOTES ON QUATERNION QUANTUM MECHANICS. (PART II). David Finkelstein, J. M. Jauch, and David Speiser. Mar. 1959. 38p.

The kinds of operators that arise naturally in quaternion quantum mechanics are indicated, and another representation theorem is given. It is shown that the logic gives rise to Hermitian operators and the dynamics gives rise to anti-Hermitian. In ordinary quantum mechanics the two are related to each other by multiplication by $i\hbar$. (auth)

11951 CF-56-4-53

Oak Ridge National Lab., Tenn.

AN ORACLE CODE FOR CALCULATION OF FERMI AGES BY NUMERICAL INTEGRATION. Melvin Tobias. Apr. 10, 1956. Decl. July 8, 1958. 36p. Contract [W-7405-eng-26]. \$6.30(ph), \$3.00(mf) OTS.

An oracle code was prepared for the calculation of Fermi ages by numerical integration. The code is designed to compute values of τ and fast and slow diffusion constants for two-group calculations from cross section data. The values of τ and the diffusion constants may be obtained for mixtures of any or all of sixteen elements. While the present tapes do not contain cross sections for sixteen different elements, cross sections may be changed in a simple and rapid manner. The thermal cross sections used for the calculation of slow diffusion constants have not yet been critically evaluated, and caution should be exercised in their use. (auth)

11952 CRL-57

Cambridge Univ., England. Cavendish [Lab.]

FLUCTUATIONS IN CHAIN PROCESSES. O. R. Frisch. Feb. 1959. 19p. (AECL-748). \$0.50(AECL).

Lectures presented at Chalk River, Aug. 1958.

Calculations for fluctuations in chain processes are presented. It is assumed throughout that the setup is fully understood, i.e., that the direction taken by random events such as the decays of individual nuclei are known. From this point it is shown how the behavior of the results may be calculated. (J.R.D.)

11953 CU-179

Columbia Univ., New York. Pupin Cyclotron Lab.
and Columbia Univ., New York. George B. Pegram Lab.

THE NEUTRON SPECTROMETER FOR SUBTHERMAL NEUTRONS AND THE CROSS SECTIONS OF GOLD AND METALLIC HYDRIDES IN THE 4-11.5A° RANGE.

Floyd T. Gould. Oct. 1, 1958. 175p. Contract AT-30-1-GEN-72. \$3.00(OTS).

The range of the single-crystal neutron spectrometer has been extended to the 4 to 11.5A (0.0052 to 0.00062 ev) range. A $\frac{3}{16}$ inch thick stack of thin mica sheets clamped between two pieces of magnesium is used as the diffractor. Polycrystalline neutron filters of beryllium oxide, and bismuth are used to remove higher order diffractions in the 4 to 8.75A range. The filtering properties of lead, magnesium, and graphite were investigated in addition to those mentioned above, and none of these was found to be sufficiently efficient for use with the spectrometer. Beyond 8.75A no crystalline filter was effective, and a mechanical monochromator was built to serve as the filter in the 8.5 to 11.5A range. The resolution of the spectrometer is 0.1A, full width at half maximum intensity, and the beam intensity diminishes as λ^{-5} from 1000 cts/second at 4A. Background is less than 1% at 4A, about 9% at 8.50A when the crystalline filters are used, and only 1% at 8.50A when the mechanical monochromator is used. Available space limits the swing of the spectrometer arm so that the longest wavelength attainable is 11.5A but, at this setting, there are 30 neutrons per second in the beam, of which only 2% is background. Higher order contamination in the filtered neutron beams is undetectable for both the polycrystalline filters and for the mechanical monochromator. The total cross section of gold was measured with high precision at one half angstrom intervals from 5 to 11.5A which region is beyond the final Bragg break (4.7A). To these data corrections for the contribution from the 4.096 ev nuclear resonance, and for thermal inelastic scattering were applied and the 2200 meter/second (thermal) absorption cross section was estimated. This represents an independent measurement of the important gold cross section. The experimental determination of the cross section of hydrogen in various compounds is of importance to chemical and physical theory. The hydrides of the metals zirconium, titanium, and palladium were carefully synthesized, and the cross section of the hydrogen was measured. Comparison of the results shows that the hydrogen cross section varies roughly as expected. Equipment and techniques for the adaptation of the single crystal neutron spectrometer to provide the very low energy neutrons were developed. The development of a method for the synthesis and analysis of the metal hydrides and the methods used for cross section measurements are also given. The synthesis of the hydrides included a determination of dissociation pressures. (auth)

11954 DP-355

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.

HEAT FLUX AT BURNOUT. Samuel Mirshak, William S. Durant, and Robert H. Towell. Feb. 1959. 16p. Contract AT(07-2)-1. \$0.50(OTS).

The heat flux that causes burnout of electrically heated surfaces that are water-cooled by forced convection was determined for both annular and rectangular coolant passages. The data are correlated by $(Q/A)_{\text{Burnout}} = 266,000 (1 + 0.0365V)(1 + 0.00914T_s) (1 + 0.0131P)$, where Q/A is the heat flux in pcu/(hr) (ft^2), V is the water velocity in ft/sec, T_s is the subcooling in degrees C, and P is the pressure in psia. Surface curvature, equivalent diameter, and material of heated surface are shown to have a negligible effect on the heat flux at burnout for the ranges studied. (auth)

11955 HW-59439

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PROCESS VESSEL PRECISION AND ACCURACY ESTIMATES. C. G. Hough. Mar. 2, 1959. 11p. Contract [W-31-109-Eng-52]. \$3.30(ph), \$2.40(mf) OTS.

An explanation is presented of the method by which the precision associated with an observed volume reading in a process vessel should be calculated based on a regression analysis of cumulative data. The types of volume measurement encountered include estimation of the total volume in a vessel at inventory time and transfer measurement consisting of estimating the volume between two levels within a tank. Conclusions concerning the behavior of this type of data are presented along with recommendations for process vessel calibration procedure. (J.R.D.)

11956 HW-59679

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DIGITAL COMPUTERS AND NUCLEAR DESIGN. D. S. Selengut. Mar. 17, 1959. 26p. Contract W-31-109-Eng-52. \$1.00(OTS).

General questions of computer philosophy are discussed, such as what constitutes design and why a computer is useful, how the availability of a modern computer determines the organization of the reactor codes that are to be set up on it, and the influence of the computer on the kind of physics and analysis one carries out in developing codes. An attempt is made to illustrate the main points in terms of specific sets of programs for nuclear design work. (W.D.M.)

11957 K-1401

Oak Ridge Gaseous Diffusion Plant, Tenn.
ON GASEOUS SELF-DIFFUSION IN CAPILLARIES.
W. H. Eberhardt. Apr. 30, 1959. 15p. Contract W-7405-eng-26. \$0.50(OTS).

The self-diffusion of a gas in a capillary has been re-examined using a density distribution which gives the same transport at the end and mid-point of the tube. This density function is chosen to be linear through the tube with effective discontinuities at the ends. Previous calculations in the limit of infinite mean free path have shown such a distribution to be reasonably reliable. The calculation reported here determines the limiting slope of the diffusion transport with increasing a/λ for right circular cylindrical capillaries of arbitrary length to radius ratio. The results are similar to those obtained previously by Pollard and Present, and Hiby and Pahl, but are believed to be more reliable. Theoretical predictions are compared with experimental data of Visner and seem to account satisfactorily for the observed decrease of the self-diffusion coefficient with increasing pressure. It is

apparent that results from considerations of self-diffusion cannot be applied directly to flow at finite pressure. (auth)

11958 KAPL-M-DIG-TD-9

Knolls Atomic Power Lab., Schenectady, N. Y.
TIGER II: AN IBM-704 DIGITAL COMPUTER PROGRAM-TEMPERATURES FROM INTERNAL GENERATION RATES. A. P. Bray and S. J. MacCracken. Feb. 28, 1959. 61p. Contract [W-31-109-Eng-52]. \$10.80(ph), \$3.90(mf) OTS.

An IBM Digital Computer Program has been developed. This program, called TIGER II, may be used on any IBM Type 704 Digital Computer which is equipped with a 16,000 word memory capacity. TIGER II is capable of determining transient as well as steady state temperature distributions in a three dimensional field containing internal heat generation. Both the boundary temperatures and the internal heat generation can vary arbitrarily in both position and time. TIGER II can handle investigations involving surface forced convection, free convection or radiation. TIGER II is the advanced form of the original TIGER program. It is not only more versatile than the original TIGER but also requires less machine time. (auth)

11959 KAPL-M-FDJ-12

Knolls Atomic Power Lab., Schenectady, N. Y.
DEPLETION SCHEMES FOR THREE-GROUP DIFFUSION THEORY CODES. R. C. Dahlberg and F. D. Judge. Feb. 13, 1959. 20p. Contract W-31-109-Eng-52. \$4.80(ph), \$2.70(mf) OTS.

Two depletion schemes are available in CUREBO: (1) discrete poison, one-group, and (2) homogeneous poison, one-group. Only one option can be exercised in a given core, however. In zoned cores, such as DIG, this is a serious drawback. In addition to the over-all code revision, which has obvious advantages, a small change in the form of the self-shielding factor was made to increase its accuracy. The one-parameter expression, given by $(1/1 + \gamma)$, was replaced by the two-parameter expression, $(K/1 + \gamma)$. The new depletion schemes are described, and the problem of determining self-shielding factors for fuel and poison are discussed. (A.C.)

11960 LA-2285

Los Alamos Scientific Lab., N. Mex.
SYSTEMS OF CONSERVATION LAWS. Peter Lax and Burton Wendroff. Nov. 1958. 39p. Contract W-7405-eng-36. \$1.25(OTS).

A wide class of difference equations is described for approximating discontinuous time dependent solutions, with prescribed initial data, of hyperbolic systems of nonlinear conservation laws. Among these schemes we determine the best ones, i.e., those which have the smallest truncation error and in which the discontinuities are confined to a narrow band of 2 to 3 meshpoints. These schemes are tested for stability and are found to be stable under a mild strengthening of the Courant-Friedrichs-Lewy criterion. Test calculations of one-dimensional flows of compressible fluids with shocks, rarefaction waves and contact discontinuities show excellent agreement with exact solutions. In particular, when Lagrange coordinates are used, there is no smearing of interfaces. The additional terms introduced into the difference scheme for the purpose of keeping the shock transition narrow are similar to, although not identical with, the artificial viscosity terms, and the like of them introduced by Richtmyer and von Neumann and elaborated by other workers in this field. (auth)

11961 LS-4

Israel. Atomic Energy Commission, Tel-Aviv.
LITERATURE SURVEY ON EMANATION POWER. Aug. 1958. 12p.

This survey contains 76 references from the published literature on emanation power. Sources considered include Chemical Abstracts, Jan. 1928 to June 1958, and Nuclear Science Abstracts, Jan. 1948 to June 1958. (W.L.H.)

11962 NARF-59-11T

Convair, Fort Worth, Tex.
AIR AND CONCRETE SCATTERING OF GAMMA RAYS. M. B. Wells. Mar. 20, 1959. 108p. Project 6-1-9964. Contract AF33(600)-32054. (MR-N-229).

A Monte Carlo method of computing the angular distribution and energy spectrum of gamma rays scattered in air and ground is described. The development of the integrals representing the contribution of each order of scattering to the total scattered flux, and the application of random sampling methods to the evaluation of these integrals, are outlined in detail. Calculation of the flux arising from pair-production interactions is also described. Results obtained in a parameter study for a source-detector height of 12.5 feet above a concrete slab are presented in both graphical and tabular form for various source energies and separation distances. (auth)

11963 NP-7376

Jackson and Moreland, Inc., Boston.
PRELIMINARY DESIGN REPORT; A CONTINUOUS QUARTER MILLION GAUSS MAGNET FACILITY FOR LINCOLN LABORATORY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, LEXINGTON, MASSACHUSETTS. June 30, 1958. 53p. Contract AF19(122)-458.

Important information developed, areas for further study, and a basis for the development of the final facility design are presented. The site chosen is on MIT property in Cambridge. In its preliminary design form, the facility is composed of an office/laboratory building and a power supply and test cell building. The electrical demand for the facility is estimated at 15,000 kva and the energy consumption at 1,000,000 kwh/month. The feature in the magnet design which permits the attainment of higher magnetic fields involves heat transfer rates in the order of 2,000 watts/cm² from the magnet conductor surfaces. (A.C.)

11964 NP-7377

Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab.
QUARTERLY PROGRESS REPORT [FOR] JUNE 1, 1958-AUGUST 31, 1958. George T. Reynolds. 61p. Contract Nonr-1858-(06).

Work on the development of filament scintillators is described. Under this development program, image tube gain measurements, light pipe coupling of image tubes, and a high-voltage pulser for image intensifiers are discussed. Preliminary results on a double cloud chamber investigation of 500-Me particles and counter results are given. The lifetime analysis of the Λ^0 and Θ^0 particles observed to decay in the 36-inch multiplate cloud chamber was completed, and the hyperons due to the interactions of neutral K mesons of negative strangeness were analyzed. (W.D.M.)

11965 NP-7382

Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab.
SIGNAL TO BACKGROUND RATIO OF GATED AND UNGATED IMAGE TUBES. Technical Report No. 20.

George T. Reynolds and D. Scarl. Nov. 12, 1958. 16p. Contract Nonr 1858(06).

A comparison is made of the signal-to-noise ratios at the output of the second stage of a two-stage tube in the case of equal phosphor lifetimes for both stages and in the case of a microsecond phosphor lifetime for the first stage and a millisecond phosphor lifetime for the second stage. In addition, the optimum gating times for a maximum signal-to-noise ratio at the output phosphor of the gated tube is examined. (J.R.D.)

11966 NP-7409

Mine Safety Appliances Co., Callery, Penna.

ELECTRICAL RESISTANCE OF A SODIUM SHORT ACROSS A TWO-CONDUCTOR CONSTANTAN LEAK DETECTION CABLE. W. Milich and E. C. King. Sept. 14, 1955. 5p. Contract NObs-65426.

An attempt was made to measure the electrical resistance of a 300, 500, and 800°F sodium short over a length of 3 in. from an approximate 10 ft length of the present two-conductor constantan, ceramic beaded leak detection cable. The resistances measured in a bridge-type circuit were very small, the highest being 0.32 ohms. For comparison, the resistance due to synthetic sea water shorting across the leads was found to be 300 ohms. (auth)

11967 NP-7421

Mine Safety Appliances Co., Callery, Penna.

CYCLIC TEST OF PRESSURE SCRAM TRANSMITTER. Memo Report 108. V. K. Heckel and E. C. King. Mar. 15, 1956. 6p. Contract NObs-65426.

An evaluation model of a pressure scram transmitter was subjected to thermal shock testing to further qualify the design. The critical section was a type 347 stainless steel to Inconel-X weld between the scram transmitter and a nominal 2 in. boss that was part of an 8 in. stainless steel pipe. The temperature was cycled between 580 and 480°F, with each change requiring 7 sec, by pumping NaK through the 8 in. pipe section at one temperature level and following this with NaK at the new temperature level. No apparent damage occurred in approximately 30 shocks. (auth)

11968 NP-7423

Mine Safety Appliances Co., Callery, Penna.

B AND W S2G EVAPORATOR AND SUPERHEATER FAILURES. Memo Report 112. R. C. Andrews, T. A. Ciarlariello, and G. H. Scharpf. May 31, 1956. 14p. Contract NObs-65426.

The B&W S2G Model Steam Generator has been undergoing steady state and cyclic tests in a 3000 kw test loop under operating conditions similar to those expected for the S2G unit. A total of 1666 hours and 1125 standard thermal cycles had been completed when a leak was indicated between the third fluid and steam system of the superheater. This memorandum gives a history of the events from the first indication of a leak to the day the evaporator and superheater were shipped to the Babcock and Wilcox Company for inspection. (auth)

11969 NP-7427

Mine Safety Appliances Co., Callery, Penna.

THERMAL SHOCK REPORT 15; THERMAL CYCLING APPLIED TO ONE IN. SOCKET WELD TEE. Memo Report 121. G. E. Kennedy and E. C. King. Oct. 31, 1956. 9p. Contract NObs-65426.

A tee in the S2G system is used to join two liquid metal streams of different temperatures. The ability of this tee to withstand the stresses imposed upon it under these conditions was questionable since it was difficult

to determine mathematically. This test subjected the tee to thermal and pressure stress. Visual, dye check and mass spectrometer examinations upon completion of the test (1829 cycles and 1048 hours of operation) showed that the test stresses were not excessive. (auth)

11970 NP-7446

Buffalo, Univ.

PROGRESS REPORT NO. 6 [FOR] JANUARY 1, 1959 TO MARCH 31, 1959. J. F. Andrew, N. Juul, J. Okada, H. E. Strauss, D. C. Wobschall, and S. Mrozowski. Apr. 3, 1959. 25p. Contract AF33(616)-5186.

The elastic properties of carbons and graphites at room temperature were investigated. Physical properties such as Young's and rigidity moduli were studied on samples after heat treatment in dry nitrogen. Results are discussed and presented graphically. Also, results of permanent set tests in laboratory-made soft filler rods are presented. Ultrasonic attenuation in carbon rods was measured, the results of which are graphically summarized, and the conclusions are drawn that the attenuation in rods of small particles is due primarily to hysteresis losses, while an additional attenuation due to scattering of sound waves by pores occurs at higher frequencies in rods made of larger particles. The magnitude of ultrasonic attenuation can be estimated from the size of the pores. A series of tests was made on carbon rods to determine the effect of the inert atmosphere on the thermal conductivity. Results of these investigations are discussed and graphically presented. Modifications to the thermal diffusivity apparatus are described as well as extrusion of soft and hard filler binder carbon samples. (For preceding period see NP-7180.) (J.R.D.)

11971 NP-7457

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON ASYMPTOTIC AND CAUSALITY CONDITION IN QUANTUM FIELD THEORY. F. Kaschlun. 1958. 13p.

It is shown that the mathematical treatment of Lehmann, Symanzik, and Zimmermann leads necessarily to a causal field theory in which the commutators of the field operators vanish for space-like distances. In order to study this fact from a more general point of view, extensive variational derivatives of the S-matrix with respect to the free-field operators as proposed by Bogolubov and co-workers are used. The manner in which Lehmann, Symanzik, and Zimmermann define and apply the asymptotic condition is investigated in more detail. Some general statements about the concept of causality in quantum field theory are made. It is indicated that only the causality condition in the form used by Bogolubov and co-workers (and not the commutator condition) is sufficient for a general approach to quantum field theory needed, for instance, in the theory of dispersion relations. (auth)

11972 NP-7462

Syracuse Univ., N. Y. Research Inst.

INTERACTIONS OF ATOMS AND IONS WITH METAL SURFACES. PART I. THE FORMATION OF HYDROGEN NEGATIVE IONS BY THE BOMBARDMENT OF TUNGSTEN SURFACE WITH HYDROGEN POSITIVE IONS. PART II. THE ANGULAR DISTRIBUTION OF THE ELECTRONS EMITTED FROM A TUNGSTEN SURFACE UNDER POSITIVE ION BOMBARDMENT. Final Technical Report [for] July 1954-September 1958. R. C. Abbott, H. W. Berry, and L. P. Levine. Sept. 1958. 84p. Project No. NR 019-610. Contract Nonr-313(00).

The formation of negative hydrogen ions by positive H ion bombardment of W and the angular distribution of electrons emitted from a W surface under positive He ion bombardment were investigated. Apparatus for use in the H negative ion experiment was designed so that electrons from two filaments in the source bombard the region inside the chamber at about 200 volts. The electrons are further guided by two small deflection plates which repel them toward the chamber and aid in focusing. The experimental procedure is described as well as the equipment, diagrams of which are also included. The data are explained in terms of a collision process for the high-energy peak of negative ions, and a process of thermal desorption for low peak of negative ions, coupled with a mechanism for the formation and neutralization of negative ions at a metal surface. In the W surface angular distribution experiments, the surface of the target was bombarded with a well-defined monoenergetic He^+ beam of adjustable energy, and the ejected electrons were analyzed to obtain the angular distribution. Experimental technique and apparatus are described as well as results which are also presented graphically. (J.R.D.)

11973 NP-7464

Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

THEORY AND APPLICATION OF THE SEPARABLE CLASS OF RANDOM PROCESSES. Technical Report 343. Albert H. Nuttall. May 26, 1958. 62p. Project No. 3-99-00-100. Contract DA-36-039-sc-64637.

The separable class of random processes is defined as that class of random processes for which the g -function, $g(x_2, \tau) = \int_{-\infty}^{\infty} (x_1 - \mu) p(x_1, x_2; \tau) dx_1$, separates into the product of two functions, one a function only of x_2 , the other a function only of τ . The second-order probability density function of the process is $p(x_2, x_2; \tau)$ and μ is its mean. Various methods of determining whether a random process is separable are developed, and basic properties of the separable class are derived. It is proved that the separability of a random process that is passed through a nonlinear no-memory device is a necessary and sufficient condition for the input-output crosscovariance function to be proportional to the input autocovariance function, whatever nonlinear device is used. The uses of this invariance property are pointed out. If a nonlinear no-memory device is replaced by a linear memory-capable network, so as to minimize the mean-square difference between the two outputs for the same separable input process, analysis shows that the optimum linear network has no memory. Simple relations among correlation functions for these circuits are also derived. Some results on Markov processes and best estimate procedure are derived, important examples of separable processes are given, and possible generalizations of separability are stated. (auth)

11974 NP-7472

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

STABLE ORBITS OF CHARGED PARTICLES IN AN OSCILLATING ELECTROMAGNETIC FIELD. Erich S. Weibel. Sept. 25, 1958. 13p. Contract AF04(647)-165. (GM-TR-0165-00481).

Orbits in a field of the cylindrical wave guide driven in the TE_{01} -mode were studied. The radial components of the Lorentz force acting on the particle is never positive regardless of its charge; thus, it is attracted toward the axis of the wave guide around which it moves in a complicated path. Sufficient conditions are given under

which the orbits are stable, that is, remain bounded for all times. (auth)

11975 NP-7473

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

PLASMA OSCILLATIONS AND DISPERSION IN THE PRESENCE OF A MAGNETIC FIELD. Myron Kantor. Nov. 26, 1958. 20p. Contract AF04(647)-165. (GM-TR-0165-00526).

A study is made of harmonic oscillations which may exist in a fully ionized, collision-free, homogeneous plasma subjected to a steady magnetic field. The plasma consists of a binary mixture of electrons and ions for which electrical neutrality is preserved. The system is described by writing the Maxwell second-order electrodynamic wave equation and the linearized equations of macroscopic motion of the particles. By transforming the vector equations to a homogeneous set of scalar algebraic equations and equating the determinant of the system to zero, one obtains for the characteristic equation of the plasma a quartic in the square of the propagation vector. This fourth degree polynomial implies, in general, the existence of four distinct modes of plasma wave propagation. It is shown that the various kinds of hydromagnetic waves, including positive-ion oscillations and Alfvén waves, all belong to the fundamental or lowest of the four modes of propagation. In general, the group and phase velocities are frequency dependent (the medium is dispersive) and are complicated functions of the angle θ between the steady magnetic field and the propagation vector or wave normal. For the limiting angles $\theta = 0, \pi/2$, the quartic can be factored and the roots calculated explicitly, leading to precise dispersion formulas in agreement with known results. For intermediate angles the factorization is discouragingly complex. However, an approximation for the fundamental mode is given and yields dispersion formulas valid for arbitrary θ . (auth)

11976 NRDC-64

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE ENERGY DISTRIBUTION OF NEUTRONS EMERGING FROM A THICK URANIUM SPHERE WITH A $^7\text{Li}(p,n)^7\text{Be}$ SOURCE PLACED AT THE CENTRE.

R. Batchelor, G. C. Morrison. Apr. 7, 1955. 4p.

The spectrum of neutrons from a spherical shell of U with a neutron source in the center was measured with a He^3 neutron spectrometer. The results are presented graphically. (J.R.D.)

11977 NYO-6375

Princeton Univ., N. J. Project Matterhorn.

PRODUCTION OF HIGH MAGNETIC FIELDS. Technical Memorandum No. 30. Daniel R. Wells. Sept. 18, 1956. 72p. \$12.30(ph), \$4.50(mf) OTS.

Current interest in rapidly pulsed coils and coils operating on direct current input prompted a search of the literature on the production of high magnetic fields. The work on direct-current high-field magnets is discussed in some detail. The practical operation of magnets of the Bitter type is described, and some difficulties that have been encountered are analyzed. Following the general methods originally suggested, a detailed analysis of optimum design criteria for direct current coils has been developed. The analysis is simplified considerably by neglecting end effects and considering a

current sheet possessing axial symmetry. It is shown that the design of a constant temperature coil can be carried through with straightforward analysis by the use of these approximations. The proof that the optimum current distribution is still approximately proportional to $(1/r)$ can now be demonstrated without the use of elliptic integrals. A study has been made of the feasibility of cryogenic cooling with a Bitter type solenoid. It is shown that the coil could be operated with inner and outer cooling jackets. A coil of this type could be operated continuously and at liquid neon temperatures could produce a field of 100,000 gauss for a total coil input power of 29 kw per meter length of coil. The total power input to the system (including power to operate the refrigerator) is reduced by a factor of forty from the corresponding value for a coil of optimum design operated with water cooling. Some of the difficulties that would be encountered with cryogenic operation are discussed and the need for some additional experimental data is noted. (auth)

11978 ORNL-2574

Oak Ridge National Lab., Tenn.

TABLES FOR THE TRANSFORMATION BETWEEN THE LABORATORY AND CENTER-OF-MASS COORDINATE SYSTEMS AND FOR THE CALCULATION OF THE ENERGIES OF REACTION PRODUCTS. J. B. Marion, T. I. Arnette, and H. C. Owens. Apr. 22, 1959. 203p. Contract W-7405-eng-26. \$3.50(OTS).

From a theoretical standpoint the most meaningful representation of angular distribution data is in the center-of-mass coordinate system. Tables were prepared to facilitate the transformation of such data between the laboratory and center-of-mass systems. These tables represent an extension of tables calculated previously by making available more entries and thus reducing the necessity for interpolation. In addition, an associated table is included which makes possible the calculation with relative ease of the energy of a nuclear reaction product as a function of the angle of observation in the laboratory system. (auth)

11979 RDB(R)/TN-17

Gt. Brit. Div. of Atomic Energy (Production), Risley, Lancs, England.

THE PHYSICAL PROPERTIES OF UF_6 . J. E. Mann. Nov. 16, 1953. 15p. (DDC/P-31).

Values of the physical properties of UF_6 are to be found in various reports and data sheets not all of which are readily available or in agreement. The present collection aims to provide, in a convenient form, acceptable values of the most commonly used properties in both c.g.s. and f.p.s. units. (auth)

11980 SCTM-61-59(51)

Sandia Corp., Albuquerque, N. Mex.

CRATERS FORMED OVER A CONCRETE STRATUM. L. N. Schofield and L. J. Vortman. Mar. 20, 1959. 15p. \$3.30(ph), \$2.40(mf) OTS.

A series of craters formed by HE in soil compacted over a concrete slab failed to show significant influence of the presence of the slab on crater dimensions and shape because of failure of the slab. It was penetrated when the fill thickness separating the charges from the concrete was 0.5 to 0.8 foot per pound^{1/2}. A definite flattening of the crater bottom occurred just before the concrete failed. The concrete stratum did not affect the crater profile when the ratio of stratum thickness to crater depth was 1 to 8. (auth)

11981 UCRL-4809

California. Univ., Livermore. Radiation Lab.

NEUTRON SELF-SHIELDING IN A SIMPLE PLANE LATTICE. Joel Bengston. Feb. 15, 1957. 10p. Contract [W-7405-eng-48]. \$1.80(ph), \$1.80(mf) OTS.

A generalization of the Serber-Wilson method was used to derive an expression for the one neutron group self-shielding factor for an absorbing material alternating with a pure moderator and scatterer in a simple plane lattice. The formula was found as accurate as a considerably more complicated double spherical harmonic calculation. (auth)

11982 UCRL-5451

California. Univ., Livermore. Lawrence Radiation Lab.

ANGULAR CORRELATION CORRECTION FACTORS VIA THE METHOD OF ROSE. Harry L. West, Jr. Jan. 6, 1959. 6p. Contract W-7405-eng-48. \$0.50(OTS).

Angular correlation correction factors are calculated for various energies for NaI crystals of sizes $1\frac{1}{2}$ inches diameter by 1 inch long, $1\frac{3}{4} \times 2$, 2×2 , and 3×3 at source to crystal distances of 3, 5, 7, and 10 cm. (auth)

11983 UCRL-5466

California. Univ., Livermore. Lawrence Radiation Lab.

TIME-DEPENDENT BEHAVIOR OF MAGNETIC FIELDS CONFINED BY CONDUCTING WALLS. Ray E. Kidder. Feb. 3, 1959. 13p. Contract W-7405-eng-48. \$0.50(OTS).

An integro-differential equation is derived that describes the total current flowing in a moving conducting surface surrounding a magnetic field. Losses by diffusion of the magnetic field into the conductor are taken into account. The conducting surfaces are surfaces of revolution of constant electrical conductivity. Two solutions of the current equation are given: (1) an analytic one for the case when the magnetic field is compressed exponentially with time, and (2) a numerical one for the case when the magnetic field is compressed linearly with time. Graphs of the compression efficiency and current versus time are presented. (auth)

11984 UCRL-5504

California. Univ., Livermore. Lawrence Radiation Lab.

PALSI—A POLYNOMIAL APPROXIMATING CODE. Richard E. von Holdt. Mar. 10, 1959. 10p. Contract W-7405-eng-48. \$0.50(OTS).

PALSI is a weighted least squares polynomial code for the IBM 704 computer. Polynomials of increasing degrees are fitted to a given set of data, the weighted residuals and inverse matrix of the normal equations are output, and if desired the values of the approximating polynomials with corresponding estimated errors are output for a set of evenly spaced arguments. (auth)

11985 UCRL-8403

California. Univ., Berkeley. Lawrence Radiation Lab.

A COMPARISON TO THEORY OF OBSERVED STABILITY FAILURES OF THIN SPHERICAL SHELLS. Garth E. Cook. Aug. 8, 1958. 25p. Contract W-7405-eng-48. \$0.75(OTS).

Experimental data on stability failures of thin spherical-shell metal windows show that the windows fail at approximately one-third the pressure calculated by the classical theory of S. Timoshenko. The experimental

data are seen to compare closely with the results calculated by the newer theories of Von Karman and Tsien. (auth)

11986 AEC-tr-3621

NEW DEVELOPMENTS IN SOVIET ATOMIC RESEARCH. Translated from *Der Aktuelle Osten*, No. 12, (1958). 6p. \$3.30(ph), \$2.40(mf) JCL or LC.

A brief review of the research being conducted with the Russian 10-Bev synchrophasatron is presented. A discussion is presented of the Russian work in controlled thermonuclear reactions from 1950 through 1958. (W.L.H.)

11987 AEC-tr-3638

SOUND TRANSMISSION THROUGH A METAL PLATE IN LIQUID OF A PLANE WAVE AT OBLIQUE INCIDENCE. J. Goetz. Translated for Argonne National Lab. from *Akust. Z.* 8, 145-68(1943). 55p. \$9.30(ph), \$3.60(mf) JCL or LC.

The sound transmissivity of solid, plane-parallel dividing walls in a liquid medium was investigated. It was found experimentally that observed total transmission can be explained as coincidence with a single tangential wave velocity. In addition, the predicted distortion of a transmitted sound beam was verified. (J.R.D.)

11988 AEC-tr-3642

SOME ASPECTS OF FUSION ROCKET PROPULSION. M. Barrère. Translated for Los Alamos Scientific Lab. from *Age Nucléaire*, No. 11, 210-15(1958). 22p. \$4.80(ph), \$2.70(mf) JCL or LC.

Principles involved in the operation of rocket engines are examined. Combustion-type engines are emphasized for both liquid and solid propellants. Free radicals and nuclear power are briefly mentioned. The phenomenon of combustion is considered as well as rocket performance, and it is pointed out that increase in reliability is long and costly but necessary if launching success is achieved. (J.R.D.)

11989 AEC-tr-3657

ULTRA-PRESSURE. III. PRESSURE-PROOF CHARACTER OF OPTICAL WINDOW. IV. PRESSURE-PROOF PACKING. Ryo Kiyama. Translated for Oak Ridge National Lab. from *Rev. Phys. Chem. Japan*, 19, 17-19; 21-4(1945). 14p. \$3.30(ph), \$2.40(mf) JCL or LC.

The design of an electrode insulator made of mica and rubber protected with steel having applications up to 20,000 kg/cm² is described. In addition, a method of setting pieces of cylindrical glass or quartz for use as high-pressure windows by pressing them without any cementing material is described. Also, large pipe connection packing is considered along with piston packing and that for hole closures, in which sealing is performed by exerting a pressure on the packing which is greater than the internal pressure. (J.R.D.)

11990 SCL-T-239

PHENOMENA IN TUNGSTEN WIRES PRECEDING THEIR EXPLOSION UNDER THE EFFECTS OF A HEAVY CURRENT. (Yavleniya v Vol'framovykh Provolokakh, Predshestvuyushchiye ikh Vzryvu pod Deystviem Sil'nogo Toka.) S. V. Lebedev. Translated by Marcel I. Weinreich (Sandia Corp.) from *Zhur. Eksptl'. i Teoret. Fiz.* 27, 605-14(1954). 33p. (Includes original, 12p.). \$6.30(ph), \$3.00(mf) JCL or LC.

During an abrupt current cut-off at 5×10^5 a/cm², tungsten does not liquefy although its energy corresponds

to the energy of the liquid state. Symptoms of the anomalous emission are observed simultaneously with symptoms of anomalous energy resistance dependence. The character of the changes which occur in the metal as it is heated by a very dense current is examined. (J.R.D.)

11991 SCL-T-240

THE LOCAL DISTRIBUTION OF SOIL "THROWOUT" FROM UNDERGROUND EXPLOSIONS. (Raspreделение na Mestnosti Grunta, Vybrasyaemogo Pri Podzemnykh Vzryvakh.) V. N. Sakharov, V. I. Kolesnikov-Svinarev, V. A. Nazarenko, and E. I. Zabidarov. Translated by Marcel I. Weinreich (Sandia Corp.) from *Doklady Akad. Nauk S.S.S.R.* 124, 314-17(1959). 9p. \$1.80(ph), \$1.80(mf) JCL or LC.

Experimental data on the total horizontal displacement of particles thrown out by an underground explosion are presented. Radioactive tracer techniques were used. It was found that the soil is thrown radially away from the center of the explosion, and the flight distance of each soil portion is determined by its position relative to the charge prior to explosion. Results are presented graphically. (J.R.D.)

11992 SCL-T-241

A PRACTICAL TECHNIQUE OF FORECASTING OROGRAPHIC PRECIPITATION. K. Kusano, K. Noguchi, and M. Sumino. Translated by Noburu Hiraga from *J. Meteorol. Research, Tokyo* 9, 811-22 (1957). 34p. \$6.30(ph), \$3.00(mf) JCL or LC.

The computation method in the prediction of 6-hours rainfall is presented. The calculation is presented graphically whenever possible, at the same time avoiding the necessity for reading lattice points. In this way a weather map indicating rainfall distribution can be drawn up. (J.R.D.)

11993 SCL-T-242

PHYSICAL PROCESSES DURING ELECTRICAL WIRE EXPLOSIONS. (Physikalische Vorgänge bei Elektrischen Drahtexplosionen.) Erwin David. Translated by Marcel I. Weinreich (Sandia Corp.) from *Z. Physik* 150, 162-71(1958). 18p. \$3.30(ph), \$2.40(mf) JCL or LC.

A typical example of a medium wire explosion is completely calculated in order to clarify the various physical processes which take place successively during the explosion. A current of several kA heats the material of the wire to a temperature of almost 10,000°C in an interval of 10^{-7} sec. Forces of inertia, supported in the beginning by magnetic forces, keep it practically in the same position. The pressure in the axis rises up to several thousand atm. This high pressure leads to an explosive expansion, in whose outset the material becomes non-conductive as a compressed gas, thus interrupting the current. The expanding metal vapor pushes an air shock-wave (detonation wave) in front of itself. The metal vapor becomes so rarefied in a few μ sec, that a normal gas discharge will ignite in it. (auth)

11994 SCL-T-245

SOME ANOMALIES IN THE BEHAVIOR OF METALS HEATED BY HIGH-SURGE PULSES (EXCERPTS). (Nekotorye Anomalii V Provedenii Metallov, Nagrevaemykh Impulsami Toka Bol'shoi Plotnosti.) S. F. Lebedev and S. E. Khaikin. Translated by Marcel I. Weinreich (Sandia Corp.) from *Zhur. Eksptl'. i Teoret. Fiz.* 26, 629-39(1954). 8p. \$1.80(ph), \$1.80(mf) JCL or LC.

The electric conductivity of metallic wire as a func-

tion of the initial energy and in the presence of a current density $\sim 10^7$ a/cm² is reported. (W.L.H.)

11995 SCL-T-246

HOW DOES A BALL LIGHTNING ORIGINATE? (Wie Entsteht Ein Kugelblitz?) Herbert Nauer. Translated by Marcel I. Weinreich (Sandia Corp.) from *Umschau Fortschr. Wiss. u. Tech.* 56 No. 3, 75-7 (1956). 12p. \$3.30(ph), \$2.40(mf) JCL or LC.

Various researchers have attempted to recreate the phenomenon of ball lightning in the laboratory in order to develop a satisfactory theory. A survey of such attempts is presented, and the properties of ball lightnings which have been gleaned from about 300 observations are summarized. (W.D.M.)

11996

CHANGE IN THE MAJOR SEMI-AXIS OF ATOMS EMITTING γ AND β PARTICLES. Ioan Stan. *Acad. rep. populare Române, Filiala Iasi, Studii cercetări științ.* 7, No. 2, 99-100 (1956). (Translated from *Referat. Zhur. Fiz.* No. 8, 1958, Abstract No. 17684.)

An examination of hydrogen-like atoms by the theory of adiabatic invariance with allowance for the intrinsic dimensions of the nucleus leads to the relation $\sqrt{mZe^2a} = \text{const.}$, where m is the mass of the electron, Ze the charge of the nucleus, and a the major semi-axis of the elliptical orbit of the electron. In the case of a radio-active nucleus, it follows from this relation that the magnitude of the major semi-axis of the orbit of the electron changes with changing charge of the nucleus, connected with the α or β process.

11997

ATOMIC SCATTERING FACTORS FOR SPHERICAL AND ASPHERICAL CHARGE DISTRIBUTIONS. A. J. Freeman (Materials Research Office, Watertown, Mass. and Massachusetts Inst. of Tech., Cambridge). *Acta Cryst.* 12, 261-71 (1959) Apr.

The atomic scattering factors for forty-five atoms and ions were calculated from Hartree and Hartree-Fock SCF wave functions and compared with the results of James & Brindley, Berghuis et al., and others. Principal scattering factors were also calculated along the lines of McWeeny for a number of atoms containing aspherical charge distributions of p electrons. A general formalism for calculating the coherent scattering of x-rays from nonspherical charge distributions as a function of atomic orientation is presented, based in part on group theoretic methods. For p electrons the results of McWeeny are reproduced. For d electrons, the scattering is completely described in terms of three principal scattering factors and the angle between the scattering vector and the atomic orientation. As illustration, specific numerical calculations are given for several atoms with incomplete d shells. A discussion of the relationship between this treatment and the usual spherical approximation is presented. (auth)

11998

AN ATOMIC SCATTERING FACTOR FOR IRON. A. J. Freeman (Materials Research Office, Watertown, Mass. and Massachusetts Inst. of Tech., Cambridge) and J. H. Wood (Massachusetts Inst. of Tech., Cambridge). *Acta Cryst.* 12, 271-9 (1959) Apr.

An atomic scattering factor for iron was calculated using self consistent field wave functions as calculated by the unrestricted Hartree-Fock method in which Slater's average exchange potential formulation was used to simplify the variational problem. As this re-

sults in separate sets of radial wave functions for the two one-electron spin directions, individual one-electron form factors were also calculated from which neutron scattering functions may be calculated. Comparison is made with the results of Viervoll & Ögrim (1949) and those obtained from the Thomas-Fermi method, with and without exchange. (auth)

11999

A NOTE ON THE MAGNETIC INTENSITIES OF POWDER NEUTRON DIFFRACTION. Gen Shirane (Westinghouse Electric Corp., Pittsburgh). *Acta Cryst.* 12, 282-5 (1959) Apr.

General intensity formulas of powder neutron diffraction lines are given for magnetic structures with a single-spin-axis as a function of the spin direction with respect to the crystallographic axes. If we disregard the vector properties of spins and assign a positive or negative scattering amplitude to the magnetic atoms, these scalar scatterers constitute a 'configurational symmetry' of the magnetic structure. When this symmetry is tetragonal, rhombohedral or hexagonal, the powder intensities cannot provide more information than the angle between the spin direction and the unique axis of the structure. The ambiguity of spin directions in α Fe₂O₃, NiAs, and MnO type structures is discussed. (auth)

12000

X-RAY SCATTERING BY BUNDLES OF CYLINDERS. R. E. Burge (Univ. of London). *Acta Cryst.* 12, 285-9 (1959) Apr.

The effects of interparticle interference on the low-angle scattering by a bundle of parallel cylinders in close-packed hexagonal array are calculated. The application of the results to the elucidation of the sizes of coherent hexagonal aggregates from x-ray scattering measurements obtained from both solid samples and solutions of long chain molecules is discussed; the calculations may also be of value in the interpretation of light-scattering results from similar solutions. (auth)

12001

PROPAGATION OF SOUND IN LIQUID METALS: THE VELOCITY IN LEAD AND TIN. R. B. Gordon (Yale Univ., New Haven). *Acta Met.* 7, 1-7 (1959) Jan.

The velocity of propagation of longitudinal sound waves in liquid lead and tin has been measured over a temperature interval upward from the freezing point. A constant linear decrease of the sonic velocity with increasing temperature is found in both metals. The acoustic data are used to evaluate the parameters in a simple hole theory of the liquid state, which is then compared with data for diffusion in liquid metals. (auth)

12002

KNIGHT SHIFT AND CALORIMETRIC MEASUREMENTS IN LIQUID SODIUM ALLOYS. R. A. Oriani and M. B. Webb (General Electric Research Lab., Schenectady, N. Y.). *Acta Met.* 7, 63-4 (1959) Jan.

The Knight shift of sodium in dilute liquid alloys Na(Hg) and Na(Au) was measured. The heat of formation of the alloys was also measured. (L.T.W.)

12003

ANALYSIS OF THE INFLUENCE OF LOW ENERGY PENETRATING PHOTONS ON THE ABSORPTION OF EXTENSIVE AIR SHOWERS IN LEAD. Jan Babecki (Inst. of Nuclear Research, Krakow). *Acta Phys. Polon.* 17, 409-15 (1958).

Continuing the previous work on photons appearing under large thicknesses of lead, experimental absorption curves were obtained from which were calculated for various thicknesses of Pb the mean number of penetrating photons leaving the absorber during one act of coincidence and the number of these photons per electron striking the absorber. The absorption coefficient was found for the photons under study and the value of this coefficient agrees with the theoretical value for an energy range of 1.2 to 7 Mev. In this manner a full picture of the phenomenon of the prolongation of the range of electron-photon cascades by photons of energies corresponding to the minimum absorption coefficient was obtained. (auth)

12004

REVERSIBLE SUSCEPTIBILITY UNDER STRESS.

Janusz Morkowski (Polish Academy of Sciences, [Wroclaw,] Poland). *Acta Phys. Polon.* 17, 435-53(1958).

The reversible susceptibility in polycrystalline nickel was measured by the alternating field method for magnetic field values up to about 68 oersteds. During the measurements the specimen was subjected to external stress, compression and tension, the values of which varied from about 14 to 21 kg/mm². The results obtained show that application of tension lowers the value of reversible susceptibility in weak fields and increases it at more intense fields as compared with the unstressed specimen. At small compressive stresses down to about 3 kg/mm² the picture is the reverse; at larger values of compressive stress, however, the reversible susceptibility is smaller for all values of magnetic field intensity than in the unstressed specimen. The results obtained are interpreted theoretically on the basis of statistical considerations. (auth)

12005

CRYSTALLOGRAPHIC DATA: URANYL DISALICYLATE TRIHYDRATE, $\text{UO}_2(\text{C}_6\text{H}_4\text{OHCOO})_2 \cdot 3\text{H}_2\text{O}$. V. Amirthalingam and V. M. Padmanabhan (Atomic Energy Establishment, Trombay, India). *Anal. Chem.* 31, 622 (1959) Apr.

12006

OF THE SOLUTION OF THE ONE DIMENSIONAL SCHRÖDINGER EQUATION IN CASE OF A POTENTIAL WELL. Olavi Hellman. *Ann. Acad. Sci. Fennicae Ser. A* 66, No. 11, 8p.(1958).

The equation is solved for the case of a potential well in which the potential field $V(x)$ is defined as V_0 for $x \leq -a$, $V_1(x)$ for $-a < x \leq 0$, $V_2(x)$ for $0 < x < +b$, and V_0 for $b \leq x$. (A.C.)

12007

SOME ECONOMIC AND TECHNOLOGICAL QUESTIONS RELATED TO THE UTILIZATION OF CONCRETE IN THE SHIELDING OF NUCLEAR REACTORS. Th. Jaeger. *Bauwirtschaft* 11, 1087-90(1957). (In German) (Translated from *Referat. Zhur. Khim.* No. 9, 1958, Abstract No. 29642.)

The basic requirements which must be met by concretes used for radiation-shielding applications are reviewed. High density, relatively high hydrogen content in the occluded water (0.4 to 1%), low heat of hydration, high specific heat capacity, high heat conductivity, a low value for the coefficient of thermal expansion and for the modulus of elasticity (resulting in a prevention of cracking and a minimization of the stresses produced by heating effects of the nuclear radiation), and a low value for the settling constant as

well as high tensile strength (to prevent cracking) are prerequisites. The most widely used formulation for medium-weight concrete (bulk density ≈ 3.5 tons/m³) is as follows: 60% barytes, 22% limonite, 11% portland cement, and 7% water; for heavy concrete (bulk density ≈ 4.3 tons/m³); 57% large and small steel scrap, 26% limonite, 13% portland cement, and 6% water. In order to increase the probability of neutron capture without emission of hard rays boron is sometimes added. The shape and particle size distribution of the heavy fillers are frequently unsatisfactory, resulting in low workability of the concrete mixtures, particularly when angular-shaped steel scrap is used as coarse aggregate. No effort should be made to reduce cement consumption since an increased cement content in the concrete results in high density of the latter, improves the workability, and increases the occluded water content. With slow-setting concretes, as is frequently the case when boron compounds are used, alumina cement should be used with the addition of calcium chloride. During the mixing of the concrete a pronounced tendency of the cement mortar to stick to the walls of the mixer is observed and can be prevented by the addition of plasticizing compounds. When steel scrap is used the stratification of the concrete when it is poured into the mold and during the subsequent vibration must be prevented. Vibration is not required when friable aggregates such as barytes are used. (auth)

12008

CALCULATION OF CHI-SQUARE TO TEST THE NO THREE-FACTOR INTERACTION HYPOTHESIS.

Marvin A. Kastenbaum (Oak Ridge National Lab., Tenn.) and Donald E. Lamphiear (Univ. of Michigan, Ann Arbor). *Biometrics* 15, 107-15(1959) Mar.

A technique is demonstrated which is particularly well suited for modern high-speed computers. The technique involves the superimposition of Newton's method of functional interaction onto the procedure suggested by Norton. (W.D.M.)

12009

RELAXATION TIMES IN NUCLEAR RESONANCE OF MOVING SAMPLE. K. Antonowicz (Univ. of Torun, Poland). *Bull. Acad. polon. sci. Classe III*, 5, 1069-72 (1957). (Translated from *Referat. Zhur. Fiz.* No. 9, 1958, Abstract No. 20598.)

The theory of signals of nuclear magnetic resonance for a moving sample is considered. It is shown that when the effective relaxation times T_{1ef} and T_{2ef} are introduced, the equations that determine the form of the signals can be reduced to the Bloch equations in which $1/T_{1ef} = 1/T_1 + 1/T_0$, where T_0 is the time taken by the specimen to pass through the coil of the transducer (analogously for T_2). A method is proposed for determining T_1 and T_2 , based on measuring the ratio of the optimum values of the radiofrequency field for different times of passage of the specimen through the coil of the transducer. The optimum volume of the radiofrequency field occurs when the condition $(\gamma H_{imax})^2 T_{1ef} T_{2ef} = 1$ is satisfied. Knowing the ratio H_{imax} for various T_0 and the values of T_0 , it is possible to determine T_1 and T_2 . The method has been verified experimentally for moving water, and the value of T_2 could be neglected as very small. Measurements were made at values of T_0 from 0.1 to 1 second and gave a value of 2.3 seconds for T_1 .

12010

EFFECT OF THE AVERAGE DIAMETER OF PURE GRAINS IN A NUCLEAR EMULSION ON THE STRUC-

TURE OF GAPS. Ahmad Isheaq and Max Morand. *Compt. rend.* 248, 1798-1800(1959) Mar. 23. (In French)

The curves of "average length of gaps vs. number of gaps" appear to be characteristics of the average diameter of grains in nuclear emulsions. (tr-auth)

12011

INTERPRETATION OF THE LOW TEMPERATURE MAGNETIZATION CURVE OF ERBIUM GALLATE. Yves Ayant and Jean Thomas (Laboratoire d'Electrostatique et de Physique du Métal, Grenoble, France). *Compt. rend.* 248, 1955-6(1959) Apr. 1. (In French)

The expression for the magnetization curve of erbium gallate is derived and compared with experimental data. (J.S.R.)

12012

ON THE ANISOTROPY OF A HETEROGENEOUS MEDIUM WITH RESPECT TO THE DIFFUSION OF NEUTRONS. [PART] I. Ladislav Trlifaj. *Czechoslov. J. Phys.* 7, 397-409(1957). (Translated from *Referat. Zhur. Fiz.* No. 6, 1958, Abstract No. 12748.)

The anisotropy of a heterogeneous medium is considered, which consists of regularly alternating layers of two different media. The monoenergetic neutrons enter the heterogeneous medium from a permanent flat source located at infinity. The dependence of the homogenized diffusion constants on the mutual orientation of the heterogeneity of the medium and on the direction of the neutrons is investigated.

12013

AN INVESTIGATION OF THE FINE STRUCTURE OF X-RAY ABSORPTION SPECTRA OF IRON IN SOME ANTIFERROMAGNETICS AND FERRITES. E. E. Vainshtein, B. I. Kotlyar, and G. A. Shapiro (Ushenskii Odessa Pedagogical Inst.). *Doklady Akad. Nauk S.S.S.R.* 125, 55-8(1959) Mar. 1. (In Russian)

Experiments were carried out in order to determine the direction and rate of changes taking place in the fine structure of x-ray absorption K spectra of iron in antiferromagnetics and ferrites and their relation to magnetic state changes of these materials. The antiferromagnetic modification of iron oxide (α -Fe₂O₃) and Co, Mn, Ni, Sr, and Zn ferrites which have a crystalline structure similar to standard spinels were selected for study with an x-ray focusing spectrograph. (R.V.J.)

12014

FUNCTIONAL EQUATIONS OF MAGNETOHYDRODYNAMICS. [S. A.] Kaplan and [B. I.] Kolodiy. *Dopovidi L'viv. Derzhav. Univ. im. I. Franka* No. 7, 229-30(1957). (Translated from *Referat. Zhur. Mekh.* No. 9, 1958, p.82.)

By means of Hopf's method a functional equation is obtained, describing the magnetohydrodynamic turbulence in an incompressible liquid:

$$\begin{aligned} \frac{\partial \Phi}{\partial t} = & \int_R y_\alpha \left(1 \frac{\partial}{\partial x_\beta} \frac{\partial^2 \Phi}{\partial y_\alpha (x) \partial x_\beta y_\alpha (x)} \right. \\ & - \frac{1}{4\pi\mu\beta} \frac{\partial}{\partial x_\beta} \frac{\partial^2 \Phi}{\partial x_\alpha (x) \partial x_\beta y_\alpha (x)} \frac{\partial}{\partial x_\alpha} \\ & + \frac{1}{8\pi\mu\beta} \frac{\partial}{\partial x_\alpha} \frac{\partial^2 \Phi}{(\partial y_\beta (x) \partial x_\beta)^2} + \nu \frac{\partial^2}{\partial x_\gamma^2} \frac{\partial \Phi}{\partial y_\alpha (x) \partial x_\gamma} + \frac{\partial \Pi}{\partial x_\alpha} \Big) dx \\ & + \int_R z_\alpha \left(1 \frac{\partial}{\partial x_\beta} \frac{\partial^2 \Phi}{\partial y_\alpha (x) \partial x_\beta z_\alpha (x)} \right. \\ & - \frac{1}{\partial x_\beta} \frac{\partial^2 \Phi}{\partial y_\alpha (x) \partial x_\beta z_\beta (x)} \frac{\partial}{\partial x_\beta} + \frac{1}{4\pi\sigma\rho} \frac{\partial^2}{\partial x_\gamma^2} \frac{\partial \Phi}{\partial z_\alpha (x) \partial x_\gamma} \Big) dx \end{aligned}$$

This equation is satisfied by a functional which is determined by the equation

$$\Phi(y(x), z(x), t) = \int_\Omega e^{i(y_\alpha v_\alpha + z_\alpha B_\alpha)} dP^t(\nu, B)$$

12015

CONTINUOUS MEASUREMENT OF A NEUTRON FLUX BY ACTIVATION OF CIRCULATING SOLUTIONS. Louis Danguay and Robert Quivy (Centre de la Faculté Polytechnique, Mons, Belgium). *Intern. J. Appl. Radiation and Isotopes* 5, 135-40(1959) Mar.

The authors describe a method for continuously measuring a neutron flux by counting the activity induced in a solution circulating in a flexible loop, which allows the detector to assume any given shape. The choice of activated material in terms of the aim it must serve is discussed. (auth)

12016

ELECTRIC FIELD INDUCED VIBRATION ROTATION SPECTRUM OF H₂ AND D₂. R. W. Terhune and C. W. Peters (Univ. of Michigan, Ann Arbor). *J. Mol. Spectroscopy* 3, 138-47(1959) Apr.

Electric field induced absorption has been observed for some 8 vibration-rotation transitions of H₂ and for 7 of D₂. An alternating electric field was used to modulate the transmitted intensity. Percentage absorptions as small as one part in 30,000 were observed with a resolution of one cm⁻¹ at 4000 cm⁻¹. From intensity measurements, the values of several polarizability matrix elements were deduced. All results were consistent with previous measurements on H₂ and D₂ and support the theory as developed by Condon. (auth)

12017

ALBEDO OF NON-STATIONARY TWO-GROUP NEUTRON CURRENTS. M. Ribarič and J. Strnad. "J. Stefan" *Inst. Repts.* (Ljubljana) 4, 3-14(1957).

The albedo of an infinite spherical reflector for two-group time-dependent neutron currents is discussed. Four particular time dependences, i.e., pulse, step, slow change, and oscillation of the inward current, are discussed in detail. (auth)

12018

THE TIME DEPENDENT TWO-GROUP NEUTRON FLUX IN A HOMOGENEOUS REFLECTOR. M. Ribarič, J. Strnad, and A. Peterlin. "J. Stefan" *Inst. Repts.* (Ljubljana) 4, 15-28(1957).

The two-group neutron flux in a spherical shell reflector at the one boundary of which the neutron flux is time dependent is discussed. A more detailed account is given of the phenomena due to the pulse, step change, oscillation, and slow change of time-dependent two-group boundary neutron fluxes. (auth)

12019

ALBEDO AND TRANSPARENCY OF REFLECTORS IN ONE-DIMENSIONAL TWO-GROUP DIFFUSION THEORY. A. Peterlin, M. Ribarič, and J. Strnad. "J. Stefan" *Inst. Repts.* (Ljubljana) 4, 29-42(1957).

The two-group calculation of the neutron flux and current at the boundaries of multi-layer reflectors and the calculation of the critical equation by means of the albedos and transparencies of single layers are discussed. Formulas are given for the calculation of the albedos and transparencies matrix elements for spherical and cylindrical shell reflectors. (auth)

12020

ALBEDO OF NON-HOMOGENEOUS ONE-GROUP NEUTRON CURRENTS. A. Peterlin, M. Ribarič, and

F. Herman. "J. Stefan" Inst. Repts. (Ljubljana) 4, 43-55(1957).

The one-group diffusion theory is employed in the study of the albedo operator of slabs and cylindrical shells of nonmultiplying materials for nonhomogeneous neutron currents. (auth)

12021

TRANSPARENCY OF A PLANE SLAB OF NON-MULTIPLYING MATERIAL FOR TIME DEPENDENT NON-HOMOGENEOUS CURRENTS. M. Ribarič and F. Herman. "J. Stefan" Inst. Repts. (Ljubljana) 4, 57-65(1957).

A brief account of the transparency of a plane slab of nonmultiplying material for nonhomogeneous time-dependent neutron fluxes is given. (auth)

12022

ON THE METHOD OF CALCULATING THE CRITICAL CONDITION FOR A PRISMATIC AND CYLINDRICAL REACTOR WITH REFLECTOR. M. Ribarič. "J. Stefan" Inst. Repts. (Ljubljana) 4, 67-75(1957).

The criticality of a prismatic and cylindrical reactor completely surrounded by a reflector is determined in the one-group diffusion theory. (auth)

12023

MEASUREMENT OF THE VAPOR PRESSURE OF LIQUID INDIUM BY MEANS OF THE MASS SPECTROGRAPH. A. P. Lyubimov and Yu. N. Lyubitov. *Moskov. Inst. Stali im. I. V. Stalina*, *Sbornik* 36, 191-5 (1957). (Translated from *Referat. Zhur. Met.* No. 4, 1958, p.314.)

A mass spectrographic method for determining the vapor pressure of a metal over its liquid phase is described. Experiments made it possible to measure the vapor pressure of metallic indium in the 646 to 1065°K range, and the heat of evaporation which proved to be 55.74 kcal/mole. The heat of evaporation was determined from the slope of the curve for the relation of vapor pressure to temperature. (W.D.M.)

12024

RAYLEIGH SCATTERING OF POLARIZED PHOTONS. D. Brini, E. Fuschini, D. S. R. Murty, and P. Veronesi (Univ. of Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). *Nuovo cimento* (10) 11, 533-45 (1959) Feb. 16.

Two criteria for comparing the theoretical predictions on the Rayleigh scattering deduced by Franz and by Brown and Mayers are discussed. The first deals with the study of the Rayleigh scattering of the polarized photons, the second considers the polarization effects due to the Rayleigh scattering of an unpolarized radiation. In the elastic scattering of polarized photons an asymmetry ratio R can be defined as $(d\sigma_0/d\Omega + \xi_{||} d\sigma/d\Omega)/(d\sigma_0/d\Omega + \xi_{\perp} d\sigma/d\Omega)$, where the numerator and the denominator represent the Rayleigh cross-section for the same angle of scattering in two orthogonal planes. The quantities $\xi_{||}$ and ξ_{\perp} are the degrees of polarization of the incident beam referred to the previous planes, while $d\sigma_0/d\Omega$ is the cross-section for the unpolarized photons and $d\sigma/d\Omega$ is the term sensitive to polarization. The value of R was determined by using a beam of photons of energy 1.28 mc^2 scattered on a target of Hg at angles of scattering $\theta_1 = 65^\circ$, $\theta_2 = 90^\circ$ and $\theta_3 = 110^\circ$. The experimental results are in closer agreement with the calculations of Brown and Mayers. The polarized beam was obtained by means of a Compton scattering at an angle of 50° of the unpolarized beam coming from a Co^{60} source. (auth)

12025

THE ASYMPTOTIC CONDITION FOR SIMPLE SCATTERING SYSTEMS. J. M. Jauch and I. I. Zinnes (CERN, Geneva and Univ. of Oklahoma, Norman). *Nuovo cimento* (10) 11, 553-67(1959) Feb. 16.

Necessary and sufficient conditions are given for an interaction operator of a simple scattering system to admit a scattering operator. The result is applied to the study of radial scalar potentials. (auth)

12026

EVAPORATION EFFECTS DURING SUPERFLOW OF LIQUID HELIUM II. K. R. Atkins, B. Rosenbaum, and H. Seki (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* 113, 751-4(1959) Feb. 1.

The rate of distillation of helium between two liquid surfaces at different temperatures was measured and found to be in approximate agreement with simple kinetic theory. The influence of evaporation on the thermal effects accompanying film flow is discussed. It seems unlikely that the decrease in the rate of film flow at small level differences can be explained in terms of these thermal effects. (auth)

12027

METALLIC TRANSITION IN LITHIUM HYDRIDE. Robert E. Behringer (Univ. of Calif., Berkeley and IBM Research Lab., Poughkeepsie, N. Y.). *Phys. Rev.* 113, 787-92(1959) Feb. 1.

The dependence on lattice parameter, or pressure, of the energy gap between the last filled and first empty energy band in LiH is investigated. The crystalline potential is approximated by a Wigner-Seitz atomic-spheres potential, corrected to account for the effects of overlapping spheres, and the wave functions are expanded in symmetrized plane waves. In addition the effect of varying the relative size of the lithium and hydrogen ion spheres is considered. The energy levels at the top of the filled band and the bottom of the empty band are determined at several values of the lattice parameter, using 6, 7, 8, 9, and 10 symmetrized plane waves. The problem of convergence is examined. The model predicts that transition to the metallic state should occur at a pressure of about 35 megabars. The results are discussed in light of recent experimental investigations. (auth)

12028

ELECTRON IMPACT IONIZATION OF Ne, O, AND N. M. J. Seaton (University College, London). *Phys. Rev.* 113, 814(1959) Feb. 1.

The Bethe approximation gives a functional relation between the cross sections for electron impact ionization (Q) and photoionization (a). Estimates of Q_N and Q_O are obtained using experimental values for Q_{Ne} and calculated values for a_N , a_O , and a_{Ne} . (auth)

12029

IONIZATION OF ATOMIC OXYGEN ON ELECTRON IMPACT. Wade L. Fite and R. T. Brackmann (General Atomic Div., General Dynamics Corp., San Diego, Calif.). *Phys. Rev.* 113, 815-16(1959) Feb. 1.

The cross section for ionization of atomic oxygen was measured by using modulated atomic beam techniques. First the ratio of the cross sections for production of the molecular oxygen ion and for total ion production in collisions of electrons with oxygen molecules was measured. Then the ratio of the ionization cross section of the free oxygen atom and the cross section for production of the molecular ion in electron-molecule collisions was determined. From the previously known total ion-

zation cross section of the molecule, and the measured ratios, the unknown cross sections were determined. The experimental results are compared with the calculations of Seaton. (auth)

12030

FORMATION OF H^- IONS BY ELECTRON IMPACT ON H_2 . G. J. Schulz (Westinghouse Electric Corp., Pittsburgh). *Phys. Rev.* **113**, 816-19(1959) Feb. 1.

The cross section for production of H^- ions by electron impact in hydrogen gas is studied. The cross section exhibits a plateau around 10 ev with a value of $1.2 \times 10^{-20} \text{ cm}^2$. A sharp peak with a cross section of $3.5 \times 10^{-20} \text{ cm}^2$ is observed at 14.2 ± 0.1 ev. The first plateau is associated with the reaction $H_2 + e \rightarrow H^- + H$ and the sharp peak with the production of hydrogen atoms in the first excited state, $H_2 + e \rightarrow H^* + H^-$. (auth)

12031

X-RAY ABSORPTION COEFFICIENTS OF THORIUM, URANIUM, AND PLUTONIUM. EXPERIMENTAL DETERMINATION AND THEORETICAL INTERPRETATION. R. B. Roof, Jr. (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 820-5(1959) Feb. 1.

The x-ray absorption coefficients of thorium, uranium, and plutonium were determined for the $K\alpha$ and $K\beta$ radiations of silver, molybdenum, copper, cobalt, iron, and chromium. Four absorption edges were found in the wavelength region covered. These were identified as the L_I , L_{II} , L_{III} , M_I edges and a M_I , M_{II} complex for plutonium. There is considerable disagreement between the experimental coefficients and the theoretical coefficients obtained from the *Internationale Tabellen*. Reasons for this discrepancy are discussed briefly. A correlation is obtained between the absorption of x-ray energy and the number of electrons in the 5f shell. Through a consideration of the atomic number, a screening constant, principal quantum numbers, and the atomic energy levels for thorium, uranium, and plutonium, the x-ray absorption coefficients of these elements were calculated. Screening constants and quantum conditions in the various equations were adjusted until, on the average, the experimental and calculated values agree within 2%. An increase in the screening constant of plutonium over that for thorium and uranium is interpreted in terms of the number of electrons occurring in the 5f shell. The change in certain quantum conditions for plutonium in comparison to those for thorium and uranium is interpreted in terms of plutonium being a subtransitional point within the 5f transition series. (auth)

12032

X-RAY ABSORPTION COEFFICIENTS OF THE ELEMENTS WITH $Z = 1$ TO 17 FOR $Mo K\alpha$ RADIATION. R. B. Roof, Jr. (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 826-7(1959) Feb. 1.

The x-ray absorption coefficients of the elements with $Z = 1$ to 17 (excluding helium and neon) were determined for $Mo K\alpha$ radiation. The values found in the present work are in better agreement with the earlier experimental data of Allen than with the semi-theoretical values given in the *Internationale Tabellen*. (auth)

12033

CONTRIBUTION OF ANNIHILATION RADIATION TO THE GAMMA-RAY FLUX IN LEAD. Martin J. Berger, J. H. Hubbell, and Ida H. Reingold (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **113**, 857-62 (1959) Feb. 1.

Multiply-scattered gamma rays from a high-energy source, upon being absorbed, give rise to a secondary flux of annihilation radiation. A procedure is developed, within the framework of the moment method of Spencer and Fano, for calculating the production and diffusion of the annihilation radiation. The treatment includes infinite as well as semi-infinite media. Numerical results are presented for primary radiation sources with energies between two and ten Mev in a lead medium. These results can be represented by simple semiempirical formulas. (auth)

12034

VELOCITY OF SOUND IN LIQUID He^3 . K. R. Atkins and H. Flicker (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* **113**, 959-61(1959) Feb. 15.

The velocity of sound in liquid He^3 along the vapor pressure curve between 1.2 and 3.2°K was measured using a pulse technique at 14 Mc/sec. Between 2 and 2.6°K the variation with pressure up to 1 atmosphere was investigated. The results are combined with other known data to calculate various thermodynamic quantities for the liquid. Available data on the specific heat along the vapor pressure curve have been converted into the more theoretically interesting case of the specific heat at constant volume along an isopycnal. The phonon contribution to the specific heat is discussed. (auth)

12035

THIRD AND FOURTH SOUND IN LIQUID HELIUM II. K. R. Atkins (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* **113**, 962-5(1959) Feb. 15.

The possible existence of two hitherto undetected types of wave propagation in liquid helium II is discussed. Third sound is a surface wave of long wavelength on a liquid helium film during which the normal component remains stationary and the superfluid component oscillates parallel to the wall. To treat this properly, it is necessary to consider temperature changes and evaporation from the surface of the film. Fourth sound may exist in narrow two-sided channels. The normal component again remains stationary and the superfluid component oscillates parallel to the wall, but the width of the channel must remain fixed and so there are oscillations in both total density and temperature. (auth)

12036

POINT SOURCE OF COSMIC RAYS IN ORION.

Y. Sekido, S. Yoshida, and Y. Kamiya (Nagoya Univ., Japan). *Phys. Rev.* **113**, 1108-14(1959) Feb. 15.

By using Geiger-Müller counter telescopes with alt-azimuth mountings, a point source of cosmic rays was found. The telescopes were kept nearly horizontal so as to observe only high-energy cosmic rays which could pass through the thick layer of the atmosphere. Upon scanning the celestial sphere, a small part of it was observed again and again during the period from April, 1954 to December, 1956, and thus the existence of a point source was established. The declination of the point source was about $0.5^\circ N$ and the right ascension was about 5 h 15 min. The average momentum of the primary particles effective for this observation would be about 280 Bev/c if they are protons. In this momentum range, the time average of the intensity was about 10% of the background cosmic rays, while there were some periodic variations during the period of observation. (auth)

12037

RECENT WORK WITH THE TRANSURANIUM ELEMENTS. Glenn T. Seaborg (Univ. of California, Berkeley). Proc. Natl. Acad. Sci. U. S. **45**, 471-82 (1959) Apr.

The history and properties of transuranic elements are reviewed. Some recent research on transuranic elements which appears to offer promise for future investigation is described. It appears that the addition of new transuranium elements to the periodic table can be expected and that their study will add much to the knowledge of atomic and nuclear structure. (A.C.)

12038

THE MAGNETIC PROPERTIES OF THE PRASEODYMIUM AND THE NEODYMIUM METALS. Tsuyoshi Murao (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Kyoto) **20**, 277-86 (1958) Sept.

The magnetic properties of praseodymium and neodymium are investigated. Because these metals have the structure of h.c.p., their crystalline field potentials cannot be uniquely determined so as to fit experimental data. The analysis is, however, qualitatively satisfactory. (auth)

12039

ON THE POSITRONIUM IN METALS. Hideo Kanazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) **20**, 400-1 (1958) Sept.

Experimental results indicate that in metals positrons reach thermal velocity in a short time and subsequently remain free, annihilating with conduction electrons. However, the possibility of the existence of positronium in metals undergoing continuous change of the electron partner may not be excluded. An electron-positron system in metals is considered, and its properties are investigated. The properties are somewhat different from those in free space. The binding energy and lifetimes were computed and tabulated for several alkali metals. The binding energies of positronium in alkali metals are smaller than that of positronium in free space and the lifetimes are longer, except in lithium. (A.C.)

12040

INDIRECT COUPLING OF NUCLEAR SPINS IN ANTIFERROMAGNET WITH PARTICULAR REFERENCE TO MnF_2 AT VERY LOW TEMPERATURES. Tuto Nakamura (Kyusyu Univ., Fukuoka, Japan). Progr. Theoret. Phys. (Kyoto) **20**, 542-52 (1958) Oct.

Indirect coupling of nuclear spins through hyperfine interaction with spin waves is discussed in the case of antiferromagnetics at very low temperatures. The line width of the F^{19} nuclear magnetic resonance in MnF_2 at 1.4°K observed by Shulman and Jaccarino (~14 gauss) proves to come mainly from this coupling. The line width of the Mn^{55} resonance in MnF_2 is also evaluated to be about 600 gauss. (auth)

12041

QUANTENTHEORIE DES ATOMS. (Quantum Theory of Atoms). A. Rubinowicz. Leipzig, Johann Ambrosius Barth, 1959. 495p.

The textbook on quantum theory of the atom is divided into two sections, the first on the fundamentals and applications of the old quantum theory and the second on the fundamentals of the new quantum theory. In the first section the discovery of the quantum, discovery of atomic nuclei, quantum states of the atom, spectrum of single electron atoms, problem of the correspondence principle, general properties of the spectrum of multi-

electron atoms, complex structure of spectral terms, the Pauli principle with a consideration of the periodic system and x-ray spectra, and band spectra are considered. The section considers physical and mathematical fundamentals of wave mechanics, simplest eigenvalue problems of wave mechanics, physical interpretation of the new quantum theory, perturbation calculation for the treatment of eigenvalue problems, the Dirac equation, and quantization of electromagnetic fields and emission and absorption of light. The final chapter contains a mathematical supplement to the chapter on eigenvalue problems of wave mechanics with the Sommerfeld polynomial method for the solution of eigenvalue problems given by differential equations of the second order. Problems covering the work of each chapter are given. (J.S.R.)

12042

RADIOAKTIVNYE IZOTOPY I IKH PRIMENENIE. (Radioactive Isotopes and Their Applications.) A. N. Nesmeyanov. Moscow, Publishing House of the Warfare and Defense Ministry of U.S.S.R., 1958. 191p.

A review is presented of the structure, properties, and preparation of radioisotopes. Tracer studies and applications in agriculture, industry, and medicine are discussed as well as their application in warfare. (R.V.J.)

12043

PROGRESS IN NUCLEAR ENERGY. SERIES I. PHYSICS AND MATHEMATICS. VOLUME 3. Edited Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958. Donald J. Hughes, J. E. Sanders, and J. Horowitz, eds. New York, Pergamon Press, 1959. 422p. \$15.00.

Selected papers from the 1958 Geneva Conference are presented. It is hoped that the number of papers will give a balanced view of the work of the Conference in connection with the fundamental neutron interactions of interest to reactor physicists. (W.D.M.)

Elementary Particles

12044 AECU-4080

Wisconsin. Univ., Madison.

GAMMA DECAY OF THE μ -MESON. M. E. Ebel and F. J. Ernst. [1959]. 9p. Contract [AT(11-1)-30]. \$1.80 (ph), \$1.80 (mf) OTS.

Attention is directed to the fact that, although the branching ratio $\rho = R(\mu^- \rightarrow e + \gamma) / R(\mu^- \rightarrow e + \bar{\nu} + \nu)$ is of the order of 10^{-8} for decays via an intermediate vector boson, there are several ways that the calculated branching ratio can be reduced sufficiently to be compatible with the experimental upper limit. The authors have individually evaluated the branching ratio and have independently obtained results which agree with each other in every particular. (A.C.)

12045 ANL-5910

Argonne National Lab., Lemont, Ill.

ON THE THEORY OF THE POLARIZATION OF NUCLEONS BY DEUTERONS. Kenneth Smith and Murray Peshkin. Apr. 1959. 371p. Contract W-31-109-eng-38. \$5.00(OTS).

In anticipation of the availability of the phase-shifts and mixing parameters, which are being calculated by Bransden, Smith, and Tate for the elastic scattering of nucleons by deuterons (with tensor forces), the von

Neuman density matrix and Racah algebra were used to derive expressions for the average value of the spin operator in the emerging beam of nucleons after single and double scattering from unpolarized deuterons. The values of the geometrical factors which appear in these expressions were calculated on an IBM-650 digital computing machine and are given in the form of tables. The range of the angular momentum quantum numbers was chosen to cover nucleon-nucleon and nucleon-deuteron problems up to J , the total angular momentum, equal to five. (auth)

12046 LS-16

Israel. Atomic Energy Commission, Tel-Aviv.

LITERATURE SURVEY ON: 1. ELEMENTARY PARTICLES (THEORETICAL). 2. ELEMENTARY PARTICLES (EXPERIMENTAL). 3. DISPERSION AND INTERACTION OF MESONS AND NUCLEONS (THEORETICAL). 4. DISPERSION AND INTERACTION OF MESONS AND NUCLEONS (EXPERIMENTAL). 5. FIELD THEORY. Dec. 1958. 76p.

A survey was made of the literature on (1) elementary particles (theoretical), (2) elementary particles (experimental), (3) dispersion and interaction of mesons and nucleons (theoretical), (4) dispersion and interaction of mesons and nucleons (experimental), and (5) field theory. Sources of information are: *Nuclear Physics* (1955-1958), *Physical Review* (1954-1958), and *Philosophical Magazine* (1954-1958). (A.C.)

12047 NP-7455

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

PARTIAL WAVE ANALYSIS OF THE PRODUCTION OF BOSON PAIRS. Sorin Ciulli and Jan Fischer. 1959. 24p.

Partial wave analysis for boson pair production on nucleons is made. The corresponding angular operators, which completely characterize the spin and angular dependence of the S -matrix, are expressed with the help of the Legendre polynomials and tabulated. Simultaneously, a general method of calculating the angular operators is given for processes containing more than four particles, in which cases the straightforward method leads to very lengthy calculations. (auth)

12048 NP-7459

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

NUCLEON STRUCTURE AND PION-PION INTERACTION. D. I. Blokhintsev, V. S. Barashenkov, and B. M. Barbashov. 1959. 12p.

The density of a meson cloud in a nucleon is calculated on the basis of the extended source theory. The nucleon periphery is determined as a region of the applicability of the one-meson state. The pion-pion interaction cross section is estimated. The coefficient of pion absorption in a nucleon found experimentally is compared with that calculated by the optical model. (auth)

12049 NYO-8546

Pennsylvania. Univ., Philadelphia.

ON MEASUREMENT OF THE LIFETIME OF THE π^0 MESON. K. Lande and W. Selove. Apr. 22, 1958. 4p. Contract AT(30-1)-2055. \$1.80(ph), \$1.80(mf) OTS.

Because the lifetime τ is not infinite, the rest mass of the π^0 is defined only within an energy uncertainty $\Delta M = \hbar/\tau$. This energy width will show up as a second spread in the Q value of the reaction $\pi^- + p \rightarrow \pi^0 + n + Q$. The kinetic energy of the neutron produced in this reaction

will show a fractional spread given by $\Delta T/T \approx \Delta M/Q$, where ΔM is the spread in mass value of the π^0 . By carrying out the reaction with π^- mesons brought to rest in hydrogen and by using a relatively simple time-of-flight method to determine the neutron energy and energy spread, it is possible with available π^- beam intensities to measure $\Delta T/T$ to about 1%. This would permit determination of the lifetime if shorter than 10^{-20} to 10^{-19} seconds. If the lifetime is longer, then the measurement would only establish this time as the lower limit to the lifetime. Reported experimental information on the lifetime gives only an upper limit, which appears to be 10^{-16} to 10^{-15} seconds. (A.C.)

12050

ON THE MAGNITUDE OF STRANGE PARTICLE PRODUCTION CROSS-SECTION IN NUCLEON-NUCLEON COLLISIONS AT COSMOTRON ENERGY. V. S. Barashenkov and V. M. Maltsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). *Acta Phys. Polon.* 17, 397-400(1958).

The probabilities of strange particle production and their momentum distribution for N-N collisions at 3 Bev are calculated by statistical theory. The results are compared with experiment. (auth)

12051

ON THE RATIO OF PHOTONS TO ELECTRONS IN EXTENSIVE AIR SHOWERS OF COSMIC RADIATION FOUND FROM ANALYSIS OF THE TRANSITION CURVE. J. M. Massalski and A. Oles (Polish Academy of Sciences and Academy of Mining and Metallurgy, Krakow). *Acta Phys. Polon.* 17, 401-8(1958).

An analysis is made of the transition curve for particles of extensive air showers of cosmic radiation, at an altitude of 2636 m above sea level. The existing discrepancy between the experimental photon-to-electron ratio (p/e) and theory is explained. In accordance with the predictions of the theory a large number of photons were found with energies below the threshold energy of apparatus for registering electrons. The photon-to-electron ratio found for a threshold energy for electrons of 15 Mev, for photons of 15 to 30 Mev, $p/e = 1.0 \pm 0.1$ is below the actual value owing to the influence of the low-energy photons on the transition curve. (auth)

12052

ON THE BILOCAL THEORY OF THE ELECTRON. E. Minardi (Istituto Nazionale di Fisica Nucleare, Turin). *Acta Phys. Polon.* 17, 429-33(1958).

The bilocal theory of the electron presented in previous work is developed in such a way that a Majorana neutrino, instead of an ordinary neutrino, is introduced in the zero approximation of the perturbation calculation for that part of the mass due to the virtual photons interacting with the internal part of the bilocal field. Moreover the contribution to the mass due to photons which interact with the part of the bilocal field describing the observable motion is calculated. The total mass obtained with the above calculation agrees with a considerable accuracy with the experimental mass of the electron if the 2.30×10^{-13} cm value of the universal length is used, i.e. the value with which the masses of other particles were previously obtained. (auth)

12053

VARIATIONS OF THE NEUTRON FLOW AT THE EARTH'S SURFACE. V. V. Cherdintsev and V. I. Meshkov. *Bull. Komissii Opredele. Absolyut. Vozrasta Geol. Formatsii, Akad. Nauk S.S.S.R., Otdel.*

Geol. Geograf. Nauk No. 1, 61-3(1955). (Translated from Referat. Zhur. Geol. No. 8, 1957, p.206.)

A comparison is given of the intensity of the neutron flow at some points of the earth's surface in the high mountain area of Kazakhstan. The data reveal a considerable variation of the density of the neutron flow depending on geological conditions. The maximum measured density was 3×10^3 neutrons $\text{cm}^{-2} \text{day}^{-1}$.

12054

DYNAMIC POLARIZATION OF PROTONS AT LOW TEMPERATURE. Michel Borghini and Anatole Abragam. *Compt. rend.* **248**, 1803-5(1959) Mar. 23. (In French)

The method of dynamic polarization, called the "solid effect," permitted an absolute polarization of 1.5% of the protons of polystyrene in a magnetic field of 12,000 gauss at a temperature of 4.2°K. (tr-auth)

12055

PHOTON COMPONENT OF EXTENSIVE ATMOSPHERIC SHOWERS. J. Dubinskii, J. M. Massalski, P. Modry, A. Oles, and J. Porebski. *Mat. fyz. časopis* **7**, 235-54(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 20027.)

Transition curves were obtained for electron-photon ratios in extensive cosmic showers. Telescopes of brass and aluminum, used in the measurements, are described. (W.D.M.)

12056

ON THE FLUCTUATION OF THE SLOWING DOWN TIME OF NEUTRONS. L. Pál and G. Németh (Central Research Inst. for Physics, Budapest). *Nukleonik* **1**, 165-7(1959) Apr.

The mean slowing down time of neutrons $t_1(u)$ and its standard deviation $D(u)$ are determined by probability calculus methods. For the relative standard deviation of the slowing down time the following relation, representing a good approximation in the case of high lethargy values, was obtained:

$$\frac{D(u)}{t_1(u)} = \frac{\sqrt{t_2(u) - t_1^2(u)}}{t_1(u)} = \sqrt{\frac{\frac{\xi/2}{21 - \alpha^2} - 1}{\frac{\xi/2}{31 - \alpha^2}}} - 1 \left\{ 1 + \frac{\xi}{2} \frac{1 + \sqrt{\alpha}}{1 - \sqrt{\alpha}} e^{-u/2} + \dots \right\}$$

where $\xi = 1 + \frac{\alpha}{1 - \alpha} \ln \alpha$ and $\alpha = \left(\frac{M-1}{M+1} \right)^2$ (M is the mass of the atomic nuclei in the slowing down medium). (auth)

12057

AN EXPERIMENTAL ANALYSIS OF TWO LARGE COSMIC RAY JETS. F. A. Brisbout and C. B. A. McCusker (Univ. of Sydney). *Nuovo cimento* (10) **11**, 484-95(1959) Feb. 16.

The true primary energy of two large jets was estimated from a study of the secondary interactions and the electromagnetic cascades resulting from the decay of π^0 mesons. This is compared with the energy estimated from $\gamma_p = 2/tg^2\eta$ and found, in both cases, to be much greater. However, good agreement with the estimate of primary energy obtained using the tunnel theory of jets is found. (auth)

12058

ABOUT THE μ -MESON SPIN FROM IONIZATION BURSTS DATA. I. X. Ion, N. J. Ionescu-Pallas and C. C. Potoceanu (Inst. of Atomic Physics of the

Rumanian Academy, Bucharest). *Nuovo cimento* (10) **11**, 507-24(1959) Feb. 16.

Accurate calculations of appearance frequencies of bursts generated by muons in a shielding layer of lead at sea level were performed. Cross sections for bremsstrahlung when the screening of the nucleus by the orbital electrons is incomplete, and Furry's distribution model revised by Christy and Kusaka in order to diminish the fluctuations, were used. Theoretical results are in good agreement with experimental data in the range 100 to 1200 particles, assuming a spin $1/2$ for the μ meson. (auth)

12059

A NOTE ON THE TRIDENT PROCESS. P. K. Aditya (Panjab Univ., Chandigarh, India). *Nuovo cimento* (10) **11**, 546-52(1959) Feb. 16.

The mean free path for direct pair production by high-energy electrons was found for electrons of mean energy 20 and 80 Bev. Electrons were obtained from high energy electromagnetic cascades recorded in nuclear emulsion stacks. Pair energies were determined by using a modified relation for the pair opening angle. The cascade theory was used to find the correction for spurious tridents. The trident mean free path values obtained at mean energy 20 and 80 Bev are 10.4 ± 1.2 and 7.7 ± 1.9 , respectively, measured in terms of the cascade unit. The results are in agreement with theoretical predictions. (auth)

12060

WEAK AND ELECTROMAGNETIC INTERACTIONS. Abdus Salam (Imperial Coll., London) and J. C. Ward (Univ. of Miami, Fla.). *Nuovo cimento* (10) **11**, 568-77(1959) Feb. 16.

The postulate of a local connection in a three-dimensional charge space leads to the introduction of three spin one fields. One of these can be identified with the electro-magnetic field and the other two can be shown to mediate all known weak interactions, thus unifying these interactions with electro-magnetism. The theory takes account of the fact that weak interactions violate parity and strangeness conservation while electromagnetic interactions do not do so. (auth)

12061

ASSOCIATED PRODUCTION BY NON-LOCAL INTERACTION. S. N. Biswas (Indian Association for the Cultivation of Science, Calcutta). *Nuovo cimento* (10) **11**, 606-8(1959) Feb. 16.

The observed associated production of the K mesons and Λ hyperons from meson-nucleon interactions in the $T = 1/2$ state may be obtained from two Feynman diagrams. In a recent paper, a composite model was introduced for K mesons. On the basis of the solution, all the observed phenomena including that of associated production could be explained. Similar conclusions were also obtained in detailed calculations by MacCarthy on the meson-nucleon compound system for the hyperon. The nature of the wave function for the composite model suggests that one may also assume the particle as elementary, having a structural co-ordinate as suggested by Yukawa for other elementary particles. (A.C.)

12062

A POSSIBLE PARITY ASSIGNMENT FOR STRANGE PARTICLES AND A NEW KIND OF HEAVY MESON. H. Katsumori (Osaka Gakugei Univ.). *Nuovo cimento* (10) **11**, 612-16(1959) Feb. 16.

The possibility has been suggested that the observed level ordering of baryon masses can be explained in the

lowest order approximation, assigning opposite parities between N and Ξ , or opposite parities between Λ and Σ as well as between N and Ξ . It was assumed that the baryons are Dirac particles and the K meson is a spinless particle. The interaction Lagrangian is given by D'Espagnat and Prentki's charge-independent interaction with common coupling constants. It appears that there is another possibility for explaining the baryon mass levels apart from such a parity assignment, assuming different coupling constants for different interaction terms. In the first approximation starting with a hypothetical condition where the strong attractions are absent, all the K and π coupling constants are assumed to be equal to the g_K and g_π , respectively, and the masses of all baryons appearing in the real and virtual states are assumed to be equal to the unrenormalized (degenerate) baryon mass. It has further been shown that the numerical estimate of the baryon mass levels is not inconsistent with observations when the reasonable magnitudes of coupling constant g_K and cut-off momentum are used. (A.C.)

12063

INELASTIC MAGNETIC SCATTERING OF NEUTRONS AT HIGH TEMPERATURES. P. G. de Gennes (Commissariat à l'Énergie Atomique, Paris). Phys. and Chem. Solids **4**, 223-6 (1958).

The magnetic scattering of neutrons by paramagnetic media with exchange interactions were studied, using the time-dependent spin correlation functions introduced by Van Hove. It is found that the even moments of the energy transfer depend strongly on momentum transfer (for small momentum transfer, all moments go to zero), and on the state of the scatterer (single crystal or powder). The shape and half-width of the spectrum are given as functions of the scattering angle for a polycrystal with nearest neighbor interactions. The whole study was confined to the high-temperature region. (auth)

12064

THEORY OF MANY-BOSON SYSTEMS: PAIR THEORY. M. Girardeau and R. Arnowitt (Syracuse Univ., N. Y.). Phys. Rev. **113**, 755-61 (1959) Feb. 1.

The many-boson system with repulsive interactions is treated by a variational method based on a variational trial state of an exponential pair-excitation type obtained by a generalization of that of Bogoliubov; the treatment is closely related to an intermediate-coupling approximation with respect to pairs. The nonlinear integral equation which determines the variational ground state is derived, and various properties of this ground state and the associated excited states are examined. The resultant low-lying spectrum lies below that of Bogoliubov by an amount proportional to the total number of particles. The variational principle is shown to produce rigorous energy eigenvalue differences for the pair part of the Hamiltonian. The variational states, however, still exhibit unphysical features characteristic of pair-excitation states: The pair correlation function does not go to zero at zero particle separation and the phonon spectrum exhibits a gap above the ground state. It is suggested that these features can be removed by using states which take into account excitation of momentum-conserving groups of more than two particles. (auth)

12065

SLOW-NEUTRON SCATTERING BY ROTATORS. Howard C. Volkin (Lewis Flight Propulsion Lab., Cleveland). Phys. Rev. **113**, 866-74 (1959) Feb. 1.

The methods of Zemach and Glauber for treating the scattering of low-energy neutrons by molecules are extended for the rotational degrees of freedom to any type of rotator. A procedure is developed which enables their results to be generalized to symmetric or asymmetric molecules. The method is then applied to the calculation of the direct scattering up to the accuracy of the first quantum-mechanical correction to the classical cross section. (auth)

12066

OPTICAL MODEL EVIDENCE FOR SURFACE ABSORPTION OF NEUTRONS. Harvey J. Amster (Westinghouse Electric Corp., Pittsburgh). Phys. Rev. **113**, 911-16 (1959) Feb. 1.

Data-matching with the complex square well model for neutron scattering suggests that the imaginary part of the potential should be largest at the nuclear surface; such an effect is also in accord with present physical pictures of the interaction. However, when a diffuse edge is attached to the model and the other parameters are changed to provide experimental agreement, the need for surface absorption appears diminished. To investigate further, cross sections resulting from a surface-absorbing and a uniformly absorbing potential, both with a diffuse edge, are calculated and compared. The results differ considerably less from each other than from the data, but the strength of absorption is more nearly independent of mass number when it is concentrated near the surface. (auth)

12067

LITHIUM, BERYLLIUM, AND BORON IN THE PRIMARY COSMIC RADIATION. P. S. Freier, E. P. Ney, and C. J. Waddington (Univ. of Minnesota, Minneapolis). Phys. Rev. **113**, 921-7 (1959) Feb. 1.

In order to resolve the controversy concerning the abundance of the light elements ($3 \leq Z \leq 5$) in the primary cosmic radiation, a further experiment was performed. The charge spectrum of the cosmic radiation was determined on October 19, 1957 in a stack of nuclear emulsions exposed nearer the top of the atmosphere than before. The results of the experiment prove that these light elements make up an appreciable fraction of all those nuclei with $Z \geq 3$ present in primary cosmic radiation. The flux values found after correction to the top of the atmosphere are, in particles/m² sec sterad: Li, Be, B (L nuclei), 1.9 ± 0.3 ; CNOF (M nuclei), 5.1 ± 0.5 ; and $Z \geq 10$ (H nuclei), 1.7 ± 0.3 . These values appear to be lower than observed previously in agreement with the decrease in the α -particle flux associated with the sun's increased activity. (auth)

12068

NEUTRAL K MESON AS A PARTICLE MIXTURE. William B. Fowler, Richard L. Lander, and Wilson M. Powell (Univ. of California, Berkeley). Phys. Rev. **113**, 928-34 (1959) Feb. 1.

This experiment was designed to demonstrate the recently predicted particle-mixture property of the neutral K meson. The prediction asserts that the neutral K meson contains a short-lived component, θ_1^0 , and a longer-lived component, θ_2^0 . The θ_2^0 should have the property that it regenerates the short-lived component and also produces hyperons upon traversing matter. Under proper conditions the observation of such mesons or hyperons demonstrates the predicted mixture property. The neutral K mesons in this experiment were produced by 1.25-Bev/ $c\pi^-$ mesons striking a $4 \times 4 \times 12$ -inch aluminum target. Neutral particles emitted from the aluminum at an angle of 5 deg with

respect to the π^- beam traveled 9.3 ft to a propane bubble chamber operated in a 12-kilogauss magnetic field. A sweeping magnet removed charged particles from this beam. θ_1^0 mesons could interact in the walls of the chamber or in the liquid propane, yielding θ_1^0 -meson and Λ^0 -hyperon decays in the sensitive region of the chamber. Twenty thousand pictures, corresponding to about 3×10^8 pions incident on the aluminum, were scanned for V^0 events. About 14 Λ^0 decays and about 12 θ_1^0 decays were observed. Spurious sources of these decays were estimated to be negligible. (auth)

12069

V-A THEORY AND THE DECAY OF THE Λ HYPERON. S. Okubo and R. E. Marshak (Univ. of Rochester, N. Y.) and E. C. G. Sudarshan (Univ. of Rochester, N. Y. and Harvard Univ., Cambridge, Mass.). Phys. Rev. **113**, 944-54(1959) Feb. 1.

The decay of the Λ hyperon is studied within the framework of the chirality-invariant four-fermion interaction. It is shown that the branching ratio of the charged and neutral modes, the s- to p-wave emission, as well as the sign and magnitude of the asymmetry parameter of the $p + \pi^-$ decay mode, can be understood on the basis of the V-A theory. Improvements upon the Born approximation, using dispersion theory, indicate that these conclusions are not invalidated by taking into account the pion-nucleon interaction. (auth)

12070

PHOTOPRODUCTION OF CHARGED π MESONS FROM NUCLEI. John R. Waters (Cornell Univ., Ithaca, N. Y.). Phys. Rev. **113**, 1133-40(1959) Feb. 15.

The γ -ray beam from the Cornell synchrotron was used to investigate the photoproduction of low-energy charged π mesons from several nuclei at 35° to the beam direction. Maximum photon energies used were 800 Mev and 1 Bev. The yields of 40 and 80 Mev π^+ and 40 Mev π mesons were observed with a detection system whose aperture was known absolutely. It was found that in some cases the meson yields were proportional to the atomic number, A, of the target rather than the more usual $A^{1/2}$. The data are compared with the predictions of an optical model of the nucleus. The deviations observed can be partially explained in terms of the inelastic scattering of high-energy mesons and of multiple meson production. An excitation function was measured for 80 Mev π^+ mesons from carbon by varying the machine energy; this indicated the presence of an appreciable number of multiply produced mesons. (auth)

12071

PHOTOPRODUCTION OF CHARGED PIONS FROM DEUTERIUM. Robert H. Land (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. **113**, 1141-6(1959) Feb. 15.

The photoproduction of charged pions from deuterium has been studied using a "monochromatic" gamma-ray beam of 292 ± 8 Mev. The energy spectra of both positive and negative pions at the laboratory angle of 120° were determined and both agreed within experimental error with that predicted by the theory of Lax and Feshbach. The negative-to-positive ratio at 120° was 1.07 ± 0.16 , and within experimental error, was independent of meson energy. At an angle of 73° the ratio was 0.90 ± 0.23 for 98.7 Mev mesons. The measured negative-to-positive ratio disagrees both with the simple classical picture of Brueckner and the phenomenological theory of Watson. Some results on the ratio using a bremsstrahlung beam are given. (auth)

12072

ALTERNATIVE METHOD FOR COMPARING PION-PROTON SCATTERING DATA WITH DISPERSION EQUATIONS. Howard J. Schnitzer and George Salzman (Univ. of Rochester, N. Y.). Phys. Rev. **113**, 1153-5(1959) Feb. 15.

A method for comparing pion-proton scattering experiments with the predictions of the forward angle scattering dispersion equations is proposed, which allows the usual statistical measure (χ^2) of the agreement. A slight discrepancy is found between negative pion-proton data and the theory; however, the over-all agreement is considered satisfactory. Values of the coupling constant and S-wave zero-energy scattering lengths are determined. They are $f^2 = 0.08 \pm 0.01$, $a_1 = 0.193 \pm 0.050$, and $a_3 = -0.089 \pm 0.048$. (auth)

12073

DECAY OF HYPERONS AND MESONS FROM THE UNIVERSAL FERMION INTERACTION. Akihiko Fujii and Masaaki Kawaguchi (Purdue Univ., Lafayette, Ind.). Phys. Rev. **113**, 1156-61(1959) Feb. 15.

The decay of the hyperon, charged pion, and K meson except K_{13}^+ is investigated on the basis of the universal V-A Fermi interaction, together with the idea of the Gell-Mann tetrahedron, by treating the virtual baryon-antibaryon pair effect in a phenomenological way. It is shown that the decay rate of K_{12}^+ calculated by the parameters adjusted to the decay of π^+ , K_{13}^+ , and K_{23}^+ is in agreement with experiment, thus suggesting a possible consistent picture of the model. (auth)

12074

COMPOSITE MODEL OF PION AND PION-NUCLEON INTERACTION. Chiaki Ihara and Shigeaki Hatano (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) **20**, 356-68(1958) Sept.

Regarding the pion as a quantum of the lowest exciting mode of a nucleon-antinucleon pair from the vacuum, a normalized wave function for the pion is obtained and used as an auxiliary variable for the treatment of the many body problem. The canonical transformation is performed to obtain an effective pion-nucleon interaction. The result is equivalent to the customary meson theory. (auth)

12075

ON THE CONSISTENCY BETWEEN THE P-WAVE DISPERSION RELATION AND THE EXPERIMENT. T. Tsuchida and A. Kanazawa (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) **20**, 395-7(1958) Sept.

Puppi and others have pointed out a discrepancy between the dispersion relation for the π^- -p scattering amplitude and experiment. A reinvestigation was made of the dispersion relation for the P-wave amplitude with new data now available. The conclusion is reached that for P-wave amplitudes there seems to be a discrepancy similar to the one pointed out by Puppi. (A.C.)

12076

ON THE RADIATIVE CORRECTIONS TO THE SCATTERING OF MESONS IN AN EXTERNAL ELECTROMAGNETIC FIELD. Anand K. Bhatia and Joseph Sucher (Univ. of Maryland, College Park). Progr. Theoret. Phys. (Kyoto) **20**, 397-8(1958) Sept.

Radiative corrections to the scattering of a spin-zero particle in an external electromagnetic field were considered by Kinoshita and Nambu using the Duffin-Kemmer formalism, also obtaining thereby the corresponding result for spin-one particles. In view of the

complexity of their calculations it was felt desirable to recalculate the effects in question, for the more important case of spin-zero particles, by a different method, the Klein-Gordon formalism. An equation was obtained which differs only slightly from that of Kinoshita and Nambu. This discrepancy was traced to a computational error. When this is rectified the calculations are in complete agreement. (A.C.)

12077

ON PARITY NONCONSERVATION. Takao Tati (Kana-zawa Univ., Japan). Progr. Theoret. Phys. (Kyoto) 20, 398-400(1958) Sept.

Parity conservation and nonconservation are discussed. The author is of the opinion that parity nonconservation has its origin in the stereographical structure of the form factor in the primary interaction in which four particles participate, in a circumstance similar to that in the structure of d and l isomers in stereochemistry. Experimental results are discussed. (A.C.)

12078

DISPERSION RELATION FOR K MESON-NUCLEON SCATTERING AND ITS APPLICATION. Keiji Igi (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 20, 403-9 (1958) Oct.

The dispersion relation is used for analyzing K-N scattering data to determine the type of the K-coupling and the magnitude of its coupling constant. The following assumptions are made: spin of K is zero, Λ and Σ have the same parities, K^+-p interaction is repulsive, and K scattering by p at low energies is isotropic. If K^-p interaction is repulsive, K coupling is scalar. If K^-p is attractive, the coupling could be either scalar or pseudoscalar depending on the energy dependence of the K^+-p scattering cross section at low energies. (auth)

12079

POSSIBLE EXPERIMENTAL TESTS ON THE DECAY INTERACTIONS OF HYPERONS. Kiyomi Itabashi (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Kyoto) 20, 457-75(1958) Oct.

Information obtainable from measurements of the characteristic quantities of $(N + \pi)$ decays of Σ and Λ hyperons is examined. In particular, the possibility of experimental tests for the $|\Delta I| = \frac{1}{2}$ rule and the postulate of time-reversal invariance is discussed. The relative magnitudes of the effective strengths of the $|\Delta I| = \frac{1}{2}$ and other (if they exist) interactions could be known under suitable assumptions on the dynamical nature of the interactions. Some physically interesting examples of such assumptions are presented and it is shown that the validity of those assumptions can be tested experimentally. For obtaining such considerably definite information, it is desirable to measure, at least, the ratio of the asymmetry parameters for various modes of decays. (auth)

12080

PERTURBATIONAL CALCULATIONS OF PROPAGATORS OF THE ELEMENTARY PARTICLES INTERACTING WITH GRAVITATIONAL FIELD. Yoshio Miyatake (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 20, 476-86(1958) Oct.

Expanding Deser's propagators by the coupling constant according to Laurent, propagators with the gravitational correction by the prescription of Hu can be calculated. If these corrected propagators are used in the calculations of S matrices, each Feynman diagram

converges except for the cases of vertex number $n = 2$ corresponding to graviton self-energy due to boson and graviton-graviton scattering, the former of which may be dropped because of gauge invariance. The larger the degree of diagram, the better the convergence. (auth)

12081

TENSOR AND SPIN-ORBIT FORCES IN NUCLEON-NUCLEON SCATTERING. Ryoza Tamagaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 20, 505-28(1958) Oct.

In order to investigate effects of a tensor force and to examine the necessity of introducing a spin-orbit force at high energies, N-N scattering at 150 Mev is analyzed. The analysis is made taking into account some characteristic features of the pion-theoretical nuclear forces. It is shown that the experimental data around 150 Mev can be well explained by two main features of nuclear forces: (1) a strong tensor force in the outer part of the interaction and (2) a hard-core-like repulsive interaction in the inner part. It should be emphasized that the former feature, which is the most characteristic one of the pion-theoretical nuclear forces, is decisively important at such high energies as well as at low energies. No positive evidences is found for such spin-orbit forces as play an important role around 150 Mev. This conclusion is in conflict with the prediction of very strong spin-orbit forces recently made by Signell and Marshak and by Gammel and Thaler. This point is discussed quite in detail. Especially, it is shown that Signell and Marshak's spin-orbit coupling potential comes from their undue reliance on the inner part of Gartenhaus' potential. (auth)

12082

MESON-MESON INTERACTION. K. Igi and K. Kawarabayashi (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 20, 576-8(1958) Oct.

Strong resonant interactions between the incident meson and the meson cloud of the nucleon were suggested phenomenologically by Dyson and Takeda as a possible interpretation for the second maximum in π^-p scattering in the Bev region. The former postulates a resonant state in $T = 0$, while the $T = 1$ state resonance is proposed by the latter. This investigation is to determine if such a resonance could be explained qualitatively from the field theoretical point of view. The conclusion can not be reached from the analysis that the resonance between pions actually occurs in the states of $T = 0$ and $T = 1$, but the possibility exists that both the states contribute to the second maximum in $\pi-p$ interactions. (A.C.)

12083

BARYON MASS SPECTRUM. H. Katsumori and K. Shimoura (Osaka Gakugei Univ.). Progr. Theoret. Phys. (Kyoto) 20, 578-80(1958) Oct.

The possibility has been pointed out that if the relative parity between nucleons and Ξ particles is assumed to be odd, the lowest order self-energies of baryons coming from the charge-independent strong interaction give the observed baryon mass level ordering. Schwinger also suggested such a level splitting in a discussion of the isospace symmetry. It is shown that the numerical estimate of mass levels in the lowest order approximation is not inconsistent with the observation when reasonable magnitudes of the coupling constant g_k and of cut-off momentum are used. The baryon mass spectra obtained are graphically shown. (A.C.)

12084

ELECTRICAL MULTIPOLE INTERNAL CONVERSION INDUCED BY NEUTRON TRANSITIONS. Hung-yuan Tzu (Inst. of Physics, Academy of China). Wu Li Hsueh Pao 13, 483-99(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19892.)

An investigation is made of the influence of the anomalous magnetic moment of the nucleon on the value of the coefficient of internal conversion. The contribution to the internal-conversion process from the scalar and longitudinal photons is described. The correspondence method is used to derive the delayed interaction between the charged particles and the anomalous magnetic moment. The results obtained are checked by means of a quantum-electrodynamical analysis. The delayed interaction obtained in this manner is applied to the calculation of the coefficient of internal conversion. It turns out that the anomalous magnetic moment of the nucleon has a negligibly small effect on the coefficient of magnetic conversion and the coefficient of electric conversion in proton transitions. However, in contradiction with the deductions obtained by many other authors, the anomalous magnetic moment of the nucleon does not cause any considerable change in the coefficient of electric conversion induced by neutron transitions.

12085

POSSIBLE CASE OF DECAY OF UNSTABLE FRAGMENT. Alojzy Tomaszewski. Zeszyty Nauk. Uniw. Łódz., Ser. II No. 3, 187-90(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19846.)

An observed double star was interpreted as a non-mesonic decay of an unstable fragment. The most likely interpretation is the decay $\text{He}^{4*} \rightarrow p + p + n + n + Q$, $Q = 158^{+18}_{-16}$ Mev.

12086

DETERMINATION OF THE AVERAGE LIFETIME OF μ -MESONS IN IRON. Ryszard Braun. Zeszyty Nauk. Uniw. Łódz., Ser. II No. 3, 191-212(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19820.)

The lifetime of μ mesons was determined to be $= 2.14 \pm 0.06$ microseconds in iron. The mesons were liberated from cosmic rays and stopped in an iron absorber. The decay electrons were observed with the aid of delayed coincidences.

Heat Transfer and Fluid Flow

12087 AAEC/E-5

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.

STUDIES OF SMALL PARTICLE SUSPENSIONS FOR L.M.F.R. PART I. FLUID FLOW WITH SUSPENSIONS SIMULATING THE U-Na SYSTEM. R. C. Cairns and K. S. Turner. Aug. 1957. 32p.

Velocities of 2.5 to 2.9 feet per second are needed to prevent settling of tungsten powder in a 1-in. i.d. horizontal pipe from aqueous suspensions containing 6.1 to 7.0 percent by weight of tungsten. In one instance a narrow moving bed was observed at a velocity of 3.8 feet per second for a suspension containing 5.0 percent of tungsten but the formation of a moving bed was not reproducible. Settling has been observed at Reynolds numbers as high as 36,300. The equation of Dallavalle, suitably modified, predicts settling velocities in a horizontal pipe of the

same order as those found experimentally for dense solid, micron-sized particle suspensions. For fully suspended flow the friction factors lie approximately 10 percent above the smooth tube, normal liquid curve. It was not found necessary to consider non-Newtonian relationships to correlate the pressure drop data. At mean Reynolds numbers above approximately 35,000 "streamlines" were observed in the lower half of the pipe for fully suspended flow. These phenomena are discussed, but a full quantitative theoretical explanation is needed together with further experimental work. (auth)

12088 MSAR-59-29

MSA Research Corp., Callery, Penna.

FINAL REPORT. (A review of the work from December 1953 to December 1958 with abstracts of reports issued.) W. J. Posey, ed. Mar. 20, 1959. 73p. Contract NObs-65426.

This report completes the task orders for research and development work on liquid metals, organics, and water technology under Contract NObs-65426. A brief general review of the work accomplished during the 5 year life of the contract is followed by a list of all reports issued, along with an abstract of each. (auth)

12089

METHODS OF MEASURING AND THE DETERMINATION OF THE HEAT CONDUCTING COEFFICIENT OF GRAPHITE AND OTHER CARBON SUBSTANCES AT TEMPERATURES UP TO 2,000°C. Tadeusz Senkara. Arch. Hutnictwa 2, 305-24(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 20161.)

A critical survey is given of the measurement of the heat conduction λ of graphite and carbon substances at temperatures from 1,000 to 2,000°C. Two methods were used for the determination of λ . In both methods, the investigated specimen was a tube and the measured quantities were the heat flux and the temperature gradient. The first variant differs from the Van Rinsum method in having a high degree of automatization of the measurements and the elimination of losses from the surface, while the second is different in that the thermal flux is measured with the aid of a calorimeter and silit-carbon thermocouples in a balanced circuit, with the investigated specimen comprising a portion of the thermocouple. The value of λ was measured to an accuracy of 5%, which did not show a tendency to increase with rising temperature.

12090

ON THE NUMERICAL INTEGRATION OF HEAT CONDUCTIVITY EQUATION. V. K. Saul'ev. Doklady Akad. Nauk S.S.S.R. 125, 48-50(1959) Mar. 1. (In Russian)

12091

SOME ASPECTS OF RADIATION PYROMETRY OF LIQUID METAL. D. Ya. Svet. Fiz. Khim. Osnovy Proizvodstva Stali, Akad. Nauk S.S.S.R., Inst. Met. Im. A.A. Baikova, Trudy 3-ei Konf. 399-409(1957). (Translation from Referat. Zhur. Met. No. 5, 1958, p.305.)

A method and apparatus are proposed for determining the radiating power of the surface of a liquid metal. The method consists of measuring the magnitude of the coefficient of reflection without interference from the flow of reflected radiation. The device consists of a system of mirrors, a shutter, a temperature lamp, a turrent with light filters, a photocell, an amplifier, and a recording device. (W.D.M.)

12092

FILM AND SUBSTRATE FLOW IN SURFACE CHANNELS. Robert S. Hansen (Iowa State Coll., Ames). *J. Phys. Chem.* **63**, 637-8(1959) Apr.

The mathematical solution of transfer rate in the transfer of monolayers in surface channels is performed by conventional hydrodynamics. (W.L.H.)

12093

FLOW-VELOCITY DISTRIBUTION AND MAGNETOHYDRODYNAMIC PRESSURE LOSSES IN THE THROAT OF A COAXIAL INDUCTION PUMP. E. K. Yankop. *Latvijas Valsts Univ., Zinatniskie Raksti* **10**, 15-20 (1957). (Translated from *Referat. Zhur. Mekh.* No. 9, 1958, p. 85.)

An analytical determination of the velocity profile in the throat of an electromagnetic pump which serves for the pumping of molten metal in terms of the wall curvature of the pump throat and the parameters of the liquid subjected to pumping is performed. Graphs are provided for the velocity profiles and the relative pressure losses.

12094

HEAT EXCHANGE BY RADIATION IN A SYSTEM OF THREE GRAY SURFACES LOCATED IN A DIATHERMAL MEDIUM. Witold Okolo-Kulak. *Zeszyty Nauk. Politech. Slask. Chem.* No. 14, 75-92(1957). (Translated from *Referat. Zhur. Fiz.* No. 9, 1958, Abstract No. 20181.)

A discussion is presented of the heat exchange by radiation between three surfaces which do not enclose the space. Starting with the energy balance, the principal relations are derived between the so-called "brightness" of the surfaces and the radiation coefficient. A method is indicated for calculating the heat exchange by radiation from any two of the three surfaces of the systems. The deductions are illustrated by means of examples.

12095

HEAT AND MASS TRANSFER. Second Edition of Introduction to the Transfer of Heat and Mass. E. R. G. Eckert and Robert M. Drake, Jr. New York, McGraw-Hill Book Co., Inc., 1959. 543p.

Part A of this volume discusses heat conduction including the theory of heat conduction and the heat conduction equation, steady and unsteady heat conduction, and heat conduction with moving boundaries. Part B is devoted to heat transfer by convection including: flow along surfaces and in channels; forced convection in laminar flow, turbulent flow, and separated flow; special heat transfer processes; free convection; and condensation and evaporation. Parts C, D, and E discuss thermal radiation, transfer of mass, and heat exchangers. (W.L.H.)

Nuclear Properties and Reactions

12096 AECU-4085

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

ISOTOPIC SOURCES OF SECONDARY RADIATION. Interim Technical Report covering the Period from June 15, 1958 to March 1, 1959. Louis Voyvodic and C. A. Stone. Mar. 17, 1959. 50p. Contract AT(11-1)-657. \$7.80(ph), \$2.30(mf) OTS.

Calculations and experimental measurements on the x-ray output of separated fission product beta sources

with a variety of target configurations and materials are given. Approximate conditions under which sources will emit nearly monochromatic x rays in the 10 to 100 kev range were found for Kr^{85} , Pm^{147} , and $\text{Sr}^{90}-\text{Y}^{90}$. The importance of thin transmission targets and source mixtures is emphasized. Two specific sources were designed, one using Kr^{85} to provide 25 kev x rays for gaging applications and one using Pm^{147} for use in radiography. Areas in which further research is indicated are discussed. (D.E.B.)

12097 AFOSR-TR-59-26

TRG, Inc., Syosset, N. Y.

RESEARCH ON NUCLEAR MAGNETIC RESONANCE TECHNIQUES. Final Report. M. Newstein. Feb. 1959. 103p. Project No. 47501. Contract AF18(600)-1313. (AD-212008).

An investigation on "shimming" an inhomogeneous magnetic field in nuclear pulses is described. The main result of this investigation is that there is a combination of "shimming" pulses that can be applied to a liquid sample that can make the line width of the sample independent of the degree of homogeneity of the external magnetic field. A mathematical analysis is made of the behavior of the transient solution and integral of the transient solution, under various conditions of excitation. A technique is described and analyzed by means of which a steady-state signal may be obtained using two resonating nuclei. A new type of maser is described. Certain pulse experiments which lead to the production of undesired signals are explained. The use of optical pumping and optical detection has allowed the observance of both Zeeman and field-independent magnetic resonances in alkali vapors. (W.D.M.)

12098 CRC-735

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE RESONANCE FLUX IN A EMPTY LATTICE POSITION IN NRX AND AN INTERCOMPARISON OF THE RESONANCE INTEGRALS OF COBALT AND U^{238} . J. P. Butler and J. S. Merritt. Jan. 1959. 36p. (AECL-772). \$1.00(AECL).

The ratio of the thermal flux to the resonance flux per unit interval of $\ln E$, (F_{th}/F_r), was determined by irradiating cobalt and uranium monitors simultaneously in an empty lattice position in the NRX reactor. Values of 38.1 ± 0.5 and 38.4 ± 0.6 were obtained with cobalt and uranium monitors, respectively, using resonance integrals including the $1/v$ part of 49.3 barns for Co^{59} and 282 barns for U^{238} . It was observed that the ratio (F_{th}/F_r) varied with the type of fuel rods in the six surrounding lattice positions. An empirical formula is given to correlate the observed variation of (F_{th}/F_r) in a lattice position with changes in the type of neighboring fuel elements. (auth)

12099 NPCC/RPWP/P-25

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A DISCUSSION OF SOME RESONANCE INTEGRALS. J. E. Sanders. [nd]. 5p.

The available data on the resonance integrals of Mg, Zr, Nb, Mo, and Bi are discussed. Recent information on Pa^{233} , U^{234} , and U^{236} is also included. (J.R.D.)

12100 NRL-5282

Naval Research Lab., Washington, D. C.

TABLE OF (p, γ) RESONANCES. J. W. Butler. Jan. 23, 1959. 23p. Project No. NR-540-000.

In measuring the (p, γ) excitation curve for a new

target isotope, one very often encounters resonances which are not due to the target nuclide but are caused by a contaminant. To facilitate the identification of such contaminants, a table of all known resonances is compiled which gives in successive columns the proton energy (there are 443 table entries, starting at 163 kev and extending to 3 Mev), the reaction, the energies of the emitted gamma rays, the cross section, the resonance width, and references to the original literature. Since the (p, α, γ) reactions on N^{15} and F^{19} lead to gamma rays in the binding energy region, and since these cross sections are very large, they are included in the table. One resonance in the $Be^9(p, \alpha, \gamma)$ reaction is also included. The approximate cutoff date of the data presented is July 1958. (auth)

12101 UCRL-5454

California. Univ., Livermore. Lawrence Radiation Lab. NEUTRON ACTIVATION CROSS SECTIONS. J. A. Miskel, K. V. Marsh, M. Lindner, and R. J. Nagle. Jan. 1959. 11p. \$0.50(OTS).

The (n, γ) activation cross sections of several nuclides were measured as a function of neutron energy. The neutron energy range covered was from 31 kev to 6 Mev. The nuclides studied were Hf^{180} , Ta^{181} , W^{186} , Au^{197} , and Th^{232} . (auth)

12102 USNRDL-TR-305

Naval Radiological Defense Lab., San Francisco. HALF-LIVES OF Pm^{149} AND Pm^{151} . L. R. Bunney, J. O. Abriam, and E. M. Scadden. Mar. 23, 1959. 13p.

Half-life values were obtained for Pm^{149} and Pm^{151} . These radionuclides were produced by short concurrent neutron irradiations of enriched Nd isotopes and purified by ion exchange chromatography after the decay of the Nd parents. Counting conditions and instruments were selected to minimize the small mutual interferences of the two radionuclides. Half-life values obtained are 53.09 ± 0.09 hr for Pm^{149} and 28.40 ± 0.04 hr for Pm^{151} . Gamma-ray scintillation spectrometry showed only one prominent gamma ray in the decay of Pm^{149} at 286 kev. This gamma ray is present in about 2% abundance. Pm^{151} exhibited prominent gamma rays at 71, 108, 170, 342, and 442 kev. (auth)

12103

POLARIZATION EFFECTS IN β DECAY ACCOMPANIED BY INTERNAL BREMSSTRAHLUNG. J. Sawicki and J. Szymanski (Warsaw Univ.). Bull. acad. polon sci. Classe III 5, 897-903(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19888.)

Beta decay of unpolarized nuclei, accompanied by internal bremsstrahlung, is investigated. The degree of circular polarization of the internal bremsstrahlung and the longitudinal polarization of the beta particles are computed. The calculations are carried out under the assumptions of the two-component neutrino theory. (W.D.M.)

12104

COEFFICIENT OF ABNORMAL INTERNAL CONVERSION OF THE 29-kev RADIATION OF Pa^{234} (UX_2). Roger Foucher. Compt. rend. 248, 1800-3(1959) Mar. 23. (In French)

The conversion coefficient α_L of the 29-kev radiation of Pa^{234} , measured by γ spectrometry in coincidence, was found to be higher than 50. This result is briefly discussed. (tr-auth)

12105

ON THE ANISOTROPY OF A HETEROGENEOUS MEDIUM WITH RESPECT TO DIFFUSION OF NEU-

TRONS. II. Ladislav Trlifaj. Czechoslov. J. Phys. 7, 468-77(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 20046.)

An investigation was made of the anisotropy of the diffusion of neutrons in the case of layered heterogeneous media with cylindrical and spherical symmetries. The diffusion length and the mean neutron flux of the homogenized medium, which scatters the neutrons anisotropically for each elementary scattering act, were calculated.

12106

THE (γ, p) REACTION ON COBALT. Miroslav Rozkos (Karlovy Univ., Prague). Czechoslov. J. Phys. 7, 499-504(1957). (Translated from Referat. Zhur. Fiz. No. 8, 1958, Abstract No. 17556.)

The energy and angular distributions of photoprotons obtained by irradiating cobalt with gamma quanta from the $Li(p, \gamma)$ reaction were measured. The energy distribution is evidence that all protons are originated by evaporation and not by direct nuclear photoeffect. Nevertheless the angular distribution is not quite isotropic and does not satisfy any of the known relations. Also measured was the energy of the reaction of formation of Fe^{58} , which equals 0.74 ± 0.16 Mev, and the energies of its excited states: 6.75, 6.44, 5.90, 5.47, 4.98, 4.35, 3.50, and 3.20 Mev.

12107

INVESTIGATION OF THE DISTRIBUTION OF THE DENSITY OF PROTONS ON A NUCLEUS. Koszo Eva Kisidine. Fiz. Szemle 7, No. 4, 95-8(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 19871.)

Using experimental data on the binding energy of a mesonic atom, values are obtained for the nuclear radius $R = (1.19 \pm 0.03) \times 10^{-13} A^{1/3}$ cm. Analyzing the data on the scattering of the electrons (100 to 500 Mev) by nuclei, the conclusion is drawn that not one model (gaussian, exponential, Fermi-distribution, etc.) of the distribution of the charge in the nucleus is in agreement with these data. It is therefore proposed not to determine the "atom factor" of the nucleus F by choosing the distribution of the proton density ρ , but to determine F from the formula for the differential cross section for scattering, and then determine ρ from the formula that determines the form factor F .

12108

CALCULATION OF THE CORRECTIONS FOR THE ANALYSIS OF THE SPECTRA AND THEIR APPLICATION TO Ho^{168} . G. Alaga and B. Jaksic (Scientific Inst., "Ruder Bosovic," Zagreb). Glasnik mat.-fiz. i Astron. Ser. II 12, 31-74(1957). (Translated from Referat. Zhur. Fiz. No. 8, 1958, Abstract No. 17506.)

A detailed analysis is made of the known methods for calculating the β -spectra corrections necessitated by the finite dimension of the nucleus and by the change in the wave function of the electron inside the nucleus. For the case $0^- \rightarrow 0^+$ transition in the decay $Ho^{168} \rightarrow Er^{166}$, the calculations were numerically evaluated. The results of the calculations are given in the form of a series of graphs. The charge distributions inside the nucleus was assumed to be parabolic. The interaction selected was a mixture of P and T variants.

12109

MOBILITY OF THE DEUTERON IN PALLADIUM UNDER THE INFLUENCE OF AN ELECTRIC FIELD. Vladimir M. Vukanovic (Inst. of Physical Chemistry, Belgrade). Glasnik Khem. Drushtva Beograd 22, No. 2, 81-6(1957).

(Translated from *Referat. Zhur. Fiz.* No. 8, 1958, Abstract No. 18029.)

An investigation was made of the mobility of light and heavy hydrogen isotopes in palladium under the influence of an electric field. These determinations were made on the basis of observation of the variation in the electric resistivity of a filament of palladium. In contrast with the data obtained by Franzini (*Nuovo cimento* **13**, 74(1936)), it was found that the mobilities of both hydrogen isotopes in the direction towards the cathode are of the same order of magnitude.

12110

U^{235} FISSION PRODUCT DECAY SPECTRA AT VARIOUS TIMES AFTER FISSION. Ann T. Nelms and J. W. Cooper (National Bureau of Standards, Washington, D. C.). *Health Phys.* **1**, 427-41(1959) Mar.

Tabulations are given of the β - and γ -ray spectra produced by the total products of U^{235} fission at times after fission from 31.2 min to 119 years. Spectra are also given which exclude radiation from fission products that form volatile compounds. (auth)

12111

THE SPECIFIC ACTIVITY OF RADIUM. G. R. Martin (Univ. of Durham, Eng.) and D. G. Tuck (Univ. of Manchester, Eng.). *Intern. J. Appl. Radiation and Isotopes* **5**, 141-5(1959) Mar.

A critical assessment has been made of the published information on disintegration energies in the radium series, and a value obtained for the mean energy deposition per radium disintegration in sealed sources of known history. This, when combined with Mann's recent calorimetric measurements on the heating effects in several national primary radium standards prepared by Hönigschmid, gives a value for the specific activity of radium of 3.655×10^{10} disintegrations per second per gram, corresponding to a disintegration constant of 4.326×10^{-4} /year, or a half life of 1602 years. (auth)

12112

I. STUDY OF INTERNAL BREMSSTRAHLUNG RADIATION, SELF-IONIZATION, AND ELECTRONS EMITTED SIMULTANEOUSLY WITH THE β RADIATION OF PHOSPHORUS-32. F. Suzor and G. Chapak (C.N.R.S., Paris). *J. phys. radium* **20**, 25-30(1959) Jan. (In French)

By analysis of the coincident impulses in two proportional counters, a study was made of the low-energy photon and electron spectrum (1 kev to 25 kev) emitted simultaneously with beta rays by P^{32} . The photon spectrum includes 2.3 kev K-line caused by autoionization of the residual atom, of intensity 5.5×10^{-4} per disintegration, and the internal bremsstrahlung continuous spectrum; the latter agrees perfectly with the theoretical prediction from 1 kev to 6 kev and then it rises strongly above the theoretical values. The electron spectrum includes the 2 kev Auger line and an important continuous spectrum. The intensity of the latter is higher than predicted by autoionization theory. The discrepancy becomes considerable from 5 kev to 25 kev where 6.6×10^{-3} associated electrons are found per disintegration. (auth)

12113

II. STUDY OF THE INTERNAL BREMSSTRAHLUNG RADIATION, SELF-IONIZATION, AND ELECTRONS EMITTED SIMULTANEOUSLY WITH THE β RADIATION OF PHOSPHORUS-32. G. Chapak and F. Suzor

(C.N.R.S., Paris). *J. phys. radium* **20**, 31-4(1959) Jan. (In French)

By analysis of the coincident impulses in two proportional counters a study was made of the low-energy photon and electron spectrum (1 kev to 20 kev) emitted simultaneously with beta rays by S^{35} . The photon spectrum includes the 2.7 kev K-line following autoionization of the residual atom, of intensity 1.8×10^{-4} per disintegration and the internal bremsstrahlung continuous spectrum of intensity of the same order of magnitude as predicted by theory from 4 kev to 10 kev. The electron spectrum comprises the Auger line of about 2 kev and a continuous spectrum which, as in P^{32} , although with smaller intensity, is much higher than predicted by autoionization theory. From 5 kev to 20 kev, 3.6×10^{-3} associated electrons are found per disintegration. (auth)

12114

STUDY OF γ RAYS PRODUCED BY THE INELASTIC SCATTERING OF FAST NEUTRONS. Boris Milman, Georges Amsel, and Marie-Claude Loyau (Laboratoire de Physique de l'École Normale Supérieure, Paris). *J. phys. radium* **20**, 51-9(1959) Jan. (In French)

The γ -ray spectra resulting from the (n, n') reaction were investigated for the nuclei Fe, Al^{27} , F^{19} , Mn^{55} , Cu, Co^{59} , P^{31} , and As^{75} , for a primary neutron energy of 2.7 Mev. The observed transitions allow the level schemes of these nuclei to be completed. (auth)

12115

PHOTOPROTONS FROM SILICON, PHOSPHORUS AND SULFUR. B. Čujec. "J. Stefan" Inst. Repts. (Ljubljana) **4**, 95-108(1957).

The energy and angular distributions of photoprotons from silicon, phosphorus, and sulfur irradiated with 32-Mev bremsstrahlung were measured. The yields of protons, expressed in units of 10^5 protons per mole per roentgen, were found to be: silicon, 3.7; phosphorus, 4.3; and sulfur, 4.8. The measured distributions were compared with predictions of compound nucleus model and Wilkinson's shell model. The energy distributions agree very well with predictions of Wilkinson's theory, whereas for angular distributions this model, neglecting all interferences, seems to be too simple. (auth)

12116

NEUTRON CAPTURE GAMMA-RAYS OF IODINE, IRIDIUM AND CERIUM. R. Balzer, H. Knoepfel, J. Lang, R. Müller, and P. Stoll (Federal Inst. of Tech., Zurich). *Nuovo cimento* (10) **11**, 609-11(1959) Feb. 16.

The (n, γ) spectra of several elements were investigated. The upper part of the measured spectrum of the reaction $I^{127}(n, \gamma)$ is graphically shown. Gamma rays with the following energies were found: 6.71, 6.45, 6.16, 5.75, 6.29, 5.99, and 5.57 Mev. Similar studies were made for Ir^{191} , Ir^{193} , and cerium. (A.C.)

12117

ENERGY DISTRIBUTION OF NEUTRONS SCATTERED BY LIQUID LEAD. I. Pelah, W. L. Whittemore, and A. W. McReynolds (General Atomic Div., General Dynamics Corp., San Diego, Calif.). *Phys. Rev.* **113**, 767-8(1959) Feb. 1.

An experiment was performed to test some of the predictions of a recent theory of neutron scattering by liquids proposed by Vineyard. Neutrons of 0.0685 ev were scattered at 90 degrees by lead at 250°, 330°, and 550°C, and the widths at half maximum of the energy distributions were determined. The width at 250°C for

solid lead was obtained for comparison purposes and found to be slightly narrower than would be predicted for a perfect gas model. The results for liquid lead show that the simple diffusion model gives a slightly broader distribution than is observed for neutrons scattered by lead near the melting point and that this model predicts a much larger variation of the width with temperature than is observed experimentally. (auth)

12118

EFFECTS OF CHEMICAL BINDING ON THE NEUTRON CROSS SECTION OF HYDROGEN. W. L. Whittemore and A. W. McReynolds (General Atomic Div., General Dynamics Corp., San Diego, Calif.). *Phys. Rev.* **113**, 806-8(1959) Feb. 1.

Fermi derived the energy dependence of the neutron scattering cross section of hydrogen chemically bound such that it acts as a harmonic oscillator. For comparison with this theory, the total cross section was measured with a high-resolution crystal spectrometer for hydrogen bound in four materials. In zirconium and yttrium hydrides, in which chemical bonding is relatively isotropic, the predicted structure with discrete energy levels is observed. In the less isotropic magnesium hydride, there is some evidence of energy levels, although not clearly resolved. For water the variation in the cross section is smooth, with no evidence of energy levels. (auth)

12119

EFFECT OF AN ELECTRIC DIPOLE MOMENT OF THE PROTON ON THE ENERGY LEVELS OF THE HYDROGEN ATOM. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 828-34 (1959) Feb. 1.

The perturbations of the energy levels of the hydrogen atom by a possible electric dipole moment of the proton, d , were obtained. The inhomogeneous equation for the first-order perturbation of the wave functions was solved analytically. The shifts of the energy levels are of the second order in d . In particular, there results a decrease of the Lamb shift between the $2S_{1/2}$ and $2P_{1/2}$ levels. By equating this decrease to the maximum allowed by the approximate agreement between the experimental and theoretical values of the Lamb shift, it is concluded that the electric dipole moment of the proton, d , must be less than 1.3×10^{-19} cm times the charge of the electron. Calculations were also carried out for the shifts of the energy levels of deuterium produced by a possible electric dipole moment of the deuteron. (auth)

12120

DIRECTIONAL CORRELATION OF GAMMA RAYS FOLLOWING THE DECAY OF Eu^{152} . R. W. Lide and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **113**, 840-4(1959) Feb. 1.

Directional correlation measurements were made on the 245 to 122 kev, 969 to 122 kev, 1118 to 122 kev, 1416 to 122 kev, 872 to 245 kev, and 1170 to 245 kev cascades in Sm^{152} , and on the 782 to 345 kev cascade in Gd^{152} . The spins of Sm^{152} are found to be 0, 2, 4, 2, 3, 3, for the ground, 122, 367, 1092, 1240, and 1538-kev levels. The 245-kev gamma ray is found to be pure quadrupole; the 872-kev gamma ray is 98% quadrupole, 2% dipole; the 969-kev gamma ray is 98% quadrupole, 2% dipole; the 1118-kev gamma ray is 99.8% quadrupole, 0.2% dipole; the 1170-kev gamma ray is 98% quadrupole, 2% dipole; the 1416-kev gamma ray is 15% quadrupole, 85% dipole. In Gd^{152} the spin of the 1127-kev level is found to be 3

and the 782-kev gamma ray is found to be pure dipole. A spin assignment of 1, 2, or 3 for the 757-kev level would not be inconsistent with the data. For any of these cases the 412-kev gamma ray must be mostly dipole; the quadrupole content must be less than 15%. (auth)

12121

NEUTRON-CAPTURE GAMMA RAYS IN Cl^{36} . R. E. Segel (Wright Air Development Center, Wright-Patterson AFB, Ohio). *Phys. Rev.* **113**, 844-51(1959) Feb. 1.

Gamma-gamma coincidences on the gamma rays following thermal neutron capture in Cl^{35} were measured. Combining these results with the energy levels in Cl^{36} known from the $\text{Cl}^{35}(\text{d,p})\text{Cl}^{36}$ reaction and the $\text{Cl}^{35}(\text{n},\gamma)\text{Cl}^{36}$ gamma-ray spectrum measured by other workers, a decay scheme is constructed which unambiguously places most of the known gamma rays in Cl^{36} . An examination is made of the reduced widths of gamma rays emanating from the capturing state, and it is shown that the reduced widths for gamma rays of the same multipolarity can fluctuate widely, and that these fluctuations do not appear to be correlated with the final-state shell model configuration. It is also shown that the reduced widths for E1 and M1 transitions emanating from the capturing state are significantly smaller than those calculated from the single-particle estimate, and that E1 transitions are more intense than M1 transitions by about a factor of four. Evidence is presented for there being collective motion present in some of the higher excited states in Cl^{36} . (auth)

12122

25-MINUTE ISOMER OF Se^{83} . R. G. Cochran and W. W. Pratt (Pennsylvania State Univ., University Park). *Phys. Rev.* **113**, 852-6(1959) Feb. 1.

Se^{83} was produced by irradiation of a selenium sample, enriched to 75% in Se^{82} , in the Pennsylvania State University research reactor. The gamma-ray spectrum of the 25-minute isomer was investigated by means of a 3-in. thick \times 3-in. diameter $\text{NaI}(\text{Tl})$ crystal scintillation spectrometer. Gamma rays of 2.294 ± 0.030 , 1.880 ± 0.015 , 1.309 ± 0.005 , 1.058 ± 0.005 , 0.833 ± 0.005 , 0.712 ± 0.010 , 0.524 ± 0.012 , 0.358 ± 0.005 , and 0.225 ± 0.005 Mev were found. The beta-ray spectrum was investigated by means of a plastic scintillator. In order to eliminate a competing activity from Se^{81} it was found essential to restrict the observation of beta rays to those in coincidence with the Se^{83} gamma spectrum. A coincidence circuit of 0.25-microsecond resolving time was developed for this purpose. The beta spectrum was found to be complex with end-point energies of approximately 0.45, 1.0, and 1.7 Mev. From these data, together with gamma-gamma coincidence measurements, a decay scheme is proposed. (auth)

12123

RADIATIONS FROM Ba^{129} . Wolfgang Henkes (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 863-5(1959) Feb. 1.

The decay of Ba^{129} produced by an $(\text{n},2\text{n})$ reaction was investigated. A new half-life value of 2.45 ± 0.05 hours is reported. Gamma rays of 1.45, 0.210, 0.182, and 0.127 Mev with relative intensities 42, 65, 100, and ~ 26 were found, with coincidences between the 1.45-Mev and 0.182-Mev gammas. Milking experiments showed 25% to 30% of Ba^{129} to decay by β^+ emission, based on assumptions about the unknown decay scheme of Cs^{129} . This result is compatible with the intensities of K x-rays, positrons, and the various gamma rays only if

unobserved γ - γ coincidences are postulated in addition to the reported ones. The result of the milking experiments is also in contradiction to the calculated K/β^+ ratio. 19% of the observed β^+ transitions are in coincidence with the 0.210 and 5.6% with the 0.127-Mev gamma rays. Because of the mentioned discrepancies, no decay scheme can be proposed. (auth)

12124

DECAY OF As^{74} . D. J. Horen, W. E. Meyerhof, J. J. Kraushaar, D. O. Wells, E. Burn, and J. E. Neighbor (Stanford Univ., Calif.). *Phys. Rev.* **113**, 875-80 (1959) Feb. 1.

The decay of As^{75} (17.5-day) was reinvestigated with single and coincidence scintillation spectrometers. The singles spectrum revealed previously unknown gamma rays of 1.19 ± 0.01 , 1.60 ± 0.04 , and 2.22 ± 0.02 Mev. X-ray-gamma coincidence measurements indicate the 1.19-Mev gamma ray is predominantly associated with the decay to Ge^{74} . Evidence is found for 0.6-0.6 Mev gamma-gamma coincidences in Ge^{74} . Based on these data, a level scheme for Ge^{74} is presented with excited states at 0.596, 1.19, and 2.22 Mev. No new information concerning the decay to Se^{74} was gained. (auth)

12125

DECAY OF Nb^{92} . Harry I. West, Jr., Lloyd G. Mann, and Glen M. Iddings (Univ. of California, Livermore). *Phys. Rev.* **113**, 881-5 (1959) Feb. 1.

The decay scheme of Nb^{92} was re-examined. Levels at 0.934 Mev (97.4% per disintegration) and 1.82 Mev (2.6%) were found. The 1.82-Mev state decays by 32% to the ground state and 68% to the 0.934-Mev state. This is in agreement with the work of Hayward, Hoppes, and Ernst. In addition a weak positron branch of $(5.6 \pm 0.6) \times 10^{-2}\%$ per disintegration was found going to the 0.934-Mev level. Also, the angular correlation of the gamma-ray cascade was measured and found to be uniquely consistent with a level assignment of 2^+ , 2^+ , 0^+ , with essentially pure M1 radiation (E2 admixture < 0.2%) for the 2^+ , 2^+ transition. The large amount of M1 radiation in this type of transition is quite exceptional. Simple theoretical considerations indicate the gamma-ray transitions to be of the single-particle type. (auth)

12126

PHOTONEUTRON CROSS SECTIONS OF Li^6 AND Li^7 . T. A. Romanowski and V. H. Voelker (Case Inst. of Tech., Cleveland). *Phys. Rev.* **113**, 886-90 (1959) Feb. 1.

The total photoneutron production cross sections for Li^6 and Li^7 were determined from the yields measured with a neutron detector. The efficiency of the neutron detector was found from the comparison of the detected and computed neutron yield from copper. In the calculation of the cross section the inverse photon matrix formulation of the photon difference method was used. The Li^6 cross section has a peak at about 12.5 Mev and its absolute value at the peak is equal to 2.8 ± 0.53 mb. The Li^7 cross section has a peak at about 14 Mev and its value at the peak is equal to 3 ± 0.75 mb. (auth)

12127

DECAY OF Pm^{143} AND Pm^{144} . Shimon Ofer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **113**, 895-9 (1959) Feb. 1.

Radioactive Pm^{143} and Pm^{144} were produced by the bombardment of Pr^{141} with α particles. Gamma rays at 475 kev, 610 kev, and 695 kev are found to be associated with the decay of Pm^{144} by K-capture to Nd^{144} . A 740-

kev gamma transition is associated with the decay of Pm^{143} by K-capture to Nd^{143} . Levels of Nd^{144} are placed at 695 kev (2^+), 1305 kev (4^+), and 1780 kev (6^+) above the ground level. Assignments of spins of levels and multipolarities of gamma-ray transitions are based on the results of measurements of conversion coefficients and gamma-gamma angular correlations. A value of $(13 \pm 4) \times 10^{-11}$ sec was found for the mean life of the 1305-kev level of Nd^{144} . An upper limit of 3×10^{-11} sec was found for the mean life of the 695-kev level of Nd^{144} (auth)

12128

SCATTERING OF NEUTRONS BY NONSPHERICAL NUCLEI. H. M. Schey (Univ. of California, Livermore). *Phys. Rev.* **113**, 900-3 (1959) Feb. 1.

A discrepancy between experiment and the optical model calculations of Bjorklund and Fernbach exists in the scattering of 7-Mev neutrons by tantalum. The possibility is investigated that this discrepancy is due to the quadrupole deformation in tantalum. The deformation is represented by a term proportional to $P_2(\cos\gamma)$ added to the spin-dependent potential of Bjorklund and Fernbach (γ is the angle between the assumed nuclear symmetry axis and the radius vector to the scattered particle). The added term is treated as a perturbation and the calculation is carried to second order. The Schrödinger equation is solved numerically on an IBM-704 computer to obtain the differential cross section for the elastic scattering of neutrons and the results are applied to the scattering of 7-Mev neutrons by tantalum. Parameters are determined which bring the theoretical results into adequate agreement with experiment. (auth)

12129

REACTION $\text{A}^{40}(\text{p},\text{n})\text{K}^{40}$ AND THE DECAY OF K^{40} .

R. E. Holland and F. J. Lynch (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **113**, 903-8 (1959) Feb. 1.

The energy difference involved in the decay of K^{40} to Ar^{40} by electron capture was measured in two ways. First, a time-of-flight technique was used to observe the neutron spectra from $\text{Ar}^{40}(\text{p},\text{n})\text{K}^{40}$ and the corresponding Q's were computed. Second, the thresholds for production of certain gamma rays from this reaction were measured; these thresholds provided another set of values for the Q's. When these Q values were combined with measurements of the gamma-ray energies, a mass difference equivalent to 1.522 ± 0.006 Mev between Ar^{40} and K^{40} and an energy release of 60 ± 8 kev in the decay of K^{40} to Ar^{40} was obtained. This appears to conflict with other information on this branch of the decay of K^{40} . (auth)

12130

COULOMB CORRECTIONS IN THE THEORY OF INTERNAL BREMSSTRAHLUNG. Larry Spruch and Wallace Gold (New York Univ.). *Phys. Rev.* **113**, 1060-8 (1959) Feb. 15.

The internal bremsstrahlung associated with allowed β decay is calculated for the case for which the gamma-ray energy is less than $2mc^2$, the kinetic energy of the electron in its final state is small compared to mc^2 , and $\text{Ze}^2/\hbar c$ is small compared to 1. It is not assumed that $(\text{Ze}^2/\hbar c)mc$ is small compared to the final momentum of the electron, or to the gamma-ray momentum. Results are obtained for the gamma-ray energy spectrum and for the angular correlation between the electrons and the gamma rays. For S^{35} , for which the above assumption would seem to be satisfied, the agreement

between theory and experiment for the number of gamma rays per β disintegration per mc^2 is better than that previously obtained; because of uncertainties in the experimental results, the extent of the improvement is not clear. Under the additional assumption that the final kinetic energy of the electron is small compared to the gamma-ray energy, an expression is derived for the polarization of the gamma rays. (auth)

12131

DISINTEGRATION SCHEME OF LONG-LIVED ALUMINUM-26. Robert A. Rightmire, James R. Simanton, and Truman P. Kohman (Carnegie Inst. of Tech., Pittsburgh). *Phys. Rev.* **113**, 1069-77(1959) Feb. 15.

The disintegration scheme of the long-lived ground-state isomer of Al^{26} was determined. The maximum positron energy as determined by absorption measurements is 1.16 ± 0.05 Mev; this agrees with the expected 1.17 Mev. The spectrum appears to be simple. The scintillation gamma spectrum shows intense positron annihilation radiation, a strong peak at 1.83 ± 0.03 Mev, and weak peaks at 1.12 ± 0.03 Mev and 2.96 ± 0.05 Mev, corresponding to transitions from the known Mg^{26} states at 1.82 and 2.97 Mev. A peak at 0.68 Mev is from the addition of two annihilation photons, one being back-scattered from the source and surroundings; the gamma of ~ 0.7 -Mev energy reported by others is not present. The peak at 2.97 Mev is shown to result from 2.97-Mev photons as well as from addition of 1.82- and 1.15-Mev photons. The relative intensities of the annihilation and gamma radiations indicate that Al^{26} undergoes $(84.6 \pm 1.8)\%$ positron emission to the 1.82-Mev state of Mg^{26} ; $(11.4 \pm 1.9)\%$ electron capture to the same state; $(3.7 \pm 0.3)\%$ electron capture to the 2.97-Mev state followed by emission of 1.15- and 1.82-Mev gamma-rays; and $(0.30 \pm 0.03)\%$ electron capture to the same state followed by 2.97-Mev radiation. Other energetically possible transitions are apparently negligible in intensity. Auger electrons and x-rays were observed in a proportional counter spectrometer. Analysis of the spectra yielded K-shell fluorescence yields of 0.008 ± 0.003 for magnesium and 0.008 ± 0.003 for aluminum. (auth)

12132

STUDY OF LEVELS IN O^{18} THROUGH THE RADIATIVE CAPTURE OF ALPHA PARTICLES BY C^{14} . H. E. Gove and A. E. Litherland (Atomic Energy of Canada, Chalk River, Ont.). *Phys. Rev.* **113**, 1078-87(1959) Feb. 15.

Two resonances in the reaction $\text{C}^{14}(\alpha, \gamma)\text{O}^{18}$ have been studied at laboratory alpha-particle energies of 1.142 ± 0.010 and 1.790 ± 0.010 Mev. These correspond to excited states in O^{18} at 7.127 and 7.630 Mev. At the upper resonance only two primary transitions are observed leading to the ground state of O^{18} and the first excited state at 1.98 Mev. Their angular distributions along with other evidence unambiguously establish spins and parities of 1- for the 7.63-Mev state, 2+ for the 1.98-Mev state, and 0+ for the ground state. Values of $\gamma = \Gamma_{\alpha} \Gamma_{\gamma} / T$ of 80 and 160 millielectron volts, respectively, are obtained for the 7.63- and 5.65-Mev E1 primary transitions. At the lower resonance again only two primary transitions are observed leading to levels in O^{18} at 1.98 and 3.55 Mev. Greater than 96% of the decays of the 3.55-Mev level lead to the 1.98-Mev level. Analysis of the angular distributions of the four gamma rays observed in the direct spectrum at this resonance, with respect to the incident beam, unambiguously es-

tablish spin and parity of 4+ to both the capturing state at 7.13 Mev and the level at 3.55 Mev. Values of γ of 15 and 12 millielectron volts, respectively, are obtained for the 3.58-Mev M1 and the 5.15-Mev E2 primary transitions. The amount of E2 mixing in the former transition is very small. (auth)

12133

NONELASTIC SCATTERING CROSS SECTION FOR 8-20 Mev NEUTRONS. T. W. Bonner and J. C. Slattery (Rice Inst., Houston, Tex.). *Phys. Rev.* **113**, 1088-90 (1959) Feb. 15.

Measurements of the nonelastic scattering cross section for neutrons with energies of 8.2, 9.8, 15.5, 17.0, 18.5, and 20.0 Mev have been made in Cu, Ag, Sn, Pb, and Bi. Cross sections were determined from transmissions through spherical shells. Neutrons of 8.2 and 9.8 Mev were obtained from the reaction $\text{Be}^9(\alpha, n)\text{C}^{12}$ and the higher energy neutrons from the reaction $\text{T}^3(d, n)\text{He}^4$. Biased scintillation detectors were used so that lower energy neutrons were not counted. The results show that the nonelastic cross sections decrease slowly with increasing neutron energy, in contrast to the cross sections for elastic scattering which show broad maxima at 7, 13, 13, 18, and 18 Mev, respectively, for Cu, Ag, Sn, Pb, and Bi. The ratio of the nonelastic cross sections to the elastic cross sections vary from a maximum value of 1.05 ± 0.05 to a minimum value of 0.71 ± 0.05 in the energy range which was covered. (auth)

12134

COINCIDENCE STUDIES IN THE DECAY OF Tb^{166} AND Tb^{154} . R. W. Henry, L. T. Dillman, N. B. Gove, and R. A. Becker (Univ. of Illinois, Urbana). *Phys. Rev.* **113**, 1090-4(1959) Feb. 15.

Tb^{166} (5.35 days) and Tb^{154} (7.5 hours and 21.5 hours) were produced by (γ, n) and $(\gamma, 5n)$ reactions on stable Tb^{159} . In addition, Tb^{154} was produced by a $(p, 2n)$ reaction on stable Gd^{157} . Gamma rays at 89 ± 1 , 200 ± 2 , 261 ± 5 , 300 ± 10 , 358 ± 5 , 420 ± 5 , 535 ± 3 , 1050 ± 10 , 1140 ± 10 , 1210 ± 10 , 1410 ± 10 , 1630 ± 20 , and 1830 ± 20 kev were associated with the 5.35-day activity, and 88 ± 1 , 123 ± 3 , 180 ± 5 , 250 ± 3 , 340 ± 10 , 511 ± 10 , 640 ± 15 and others greater than 1600 kev were associated with 21.5-hour and shorter activities. Levels of Gd^{156} are placed at $89(2+)$, $289(4+)$, 1140 , 1500 , and 2035 kev above the ground state. These follow electron capture in 5.35-day Tb^{166} . The K-shell conversion coefficients of the 89- and 200-kev transitions are determined to be about 1.0 and 0.16, respectively. (auth)

12135

PHOTONUCLEAR REACTIONS OF GALLIUM AND ARSENIC WITH 70-Mev BREMSSTRAHLUNG. Fritz D. Schupp, Clifford B. Colvin, and Don S. Martin, Jr. (Iowa State Coll., Ames). *Phys. Rev.* **113**, 1095-8(1959) Feb. 15.

Radiochemical techniques were utilized in the measurement of yields of photonuclear reactions induced by 70-Mev bremsstrahlung in gallium and arsenic targets. For As targets the yields of As^{74} , Ga^{73} , Ga^{72} , Ga^{68} , Zn^{69} , and Zn^{69m} were determined. In the gallium targets the yields of Zn^{69} , Zn^{69m} , Ni^{65} , and Co^{61} were measured. The integrated cross sections for the indicated photonuclear reactions were estimated from the yields. The integrated cross sections of five $(\gamma, 3p3n)$ processes were compared. The relative yields of the Zn^{69} isomeric pair depended upon the process of formation. (auth)

12136

POLARIZATION OF SCATTERED PROTONS NEAR 17 Mev. William A. Blanpied (Princeton Univ., N. J.). Phys. Rev. **113**, 1099-1104(1959) Feb. 15.

Experimental angular distributions of the polarization of protons elastically scattered from magnesium, calcium, copper, silver, and gold near 17 Mev are presented, and comparison with certain theoretical calculations made. Data are also given on the polarization of inelastic protons scattered from magnesium with $Q = -1.37$ Mev. The familiar double-scattering method was used, with carbon serving as second scatterer. It is concluded that appreciable elastic polarization may be universally expected at this energy, and that therefore some form of spin-orbit interaction is important. (auth)

12137

ATOMIC MASSES OF THE STABLE ISOTOPES OF LEAD AND MERCURY AND THE MASS DIFFERENCE $D_2\text{-He}^4$. Jay L. Benson, Richard A. Damerow, and Richard R. Ries (Univ. of Minnesota, Minneapolis). Phys. Rev. **113**, 1105-7(1959) Feb. 15.

Mass doublets have been measured from which atomic masses for the stable isotopes of mercury and lead are found. The doublet $D_2\text{-He}^4$ has also been measured and found to have a value 25.6074 ± 3 mMU. (auth)

12138

EMISSION OF HEAVY FRAGMENTS IN NUCLEAR DISINTEGRATIONS. O. Skjeggstad and S. O. Sørensen (Univ. of Oslo). Phys. Rev. **113**, 1115-24(1959) Feb. 15.

A phenomenological description is given of the processes which lead to the emission of energetic heavy fragments from cosmic-ray stars. The energy spectra, angular distribution, and relative frequency of the particles were determined, and a detailed comparison is made with the predictions from nuclear evaporation theory. A simple method for charge determination of the fragments is described. (auth)

12139

STUDY OF THALLIUM, LEAD, AND BISMUTH NUCLEI PRODUCED IN THE BOMBARDMENT OF GOLD WITH 380-Mev PROTONS. Albert E. Metzger and J. M. Miller (Columbia Univ., New York). Phys. Rev. **113**, 1125-33(1959) Feb. 15.

Gold was bombarded by the 380-Mev proton beam of the Nevis Cyclotron in a study of secondary reactions. Secondary reactions produce nuclei with charges greater than that of a target nucleus by means of an intermediate fragment emitted from one target nucleus and absorbed in a second. The increase in atomic number permits isolation of the effect by chemical separation. Thallium, lead, and bismuth fractions were separated from irradiated gold bars and carefully purified. The radioactive decay of these samples was followed with a NaI(Tl) crystal scintillation counter. Nuclei produced by secondary reactions were detected for all three elements, the yields decreasing rapidly with increasing atomic number. From the secondary reaction yields of thallium and lead isotopes, it has been possible to calculate the upper portion of the energy distribution of the respective intermediate alpha and lithium fragments. This provides a comprehensive picture of a secondary reaction and demonstrates (1) that the yield of secondary particles is a rapidly increasing function of the bombardment energy for a given target

nucleus, (2) that the energy distribution of the secondary fragment possesses an appreciable high-energy tail, and (3) that secondary reactions can be treated in terms of conventional nuclear reaction theory. (auth)

12140

EFFECT OF RECOIL ON THE ELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS BY ZERO-SPIN NUCLEI. Leslie L. Foldy (Case Inst. of Tech., Cleveland), Kenneth W. Ford (Los Alamos Scientific Lab., N. Mex.), and Donald R. Yennie (Univ. of Minnesota, Minneapolis). Phys. Rev. **113**, 1147-53(1959) Feb. 15.

The effect of nuclear recoil on the elastic scattering of high-energy electrons or muons by zero-spin nuclei is studied by adapting the Breit two-particle Hamiltonian to the case that one of the two particles is of finite size, is spinless, and is nonrelativistic, the other being a normal point Dirac particle. A radial and angular separation of the Dirac equation is still possible. To leading order in the parameter (electron energy)/(nuclear mass), the effect of the dynamic recoil terms is to rotate the scattering amplitude vectors in the complex plane without changing their magnitudes, a result which is independent of the shape and size of the nuclear charge distribution. To this order, the cross section is affected only by the kinematic recoil corrections. The dynamic recoil terms also influence the scattering amplitudes through terms of order (electron mass)/(nuclear mass). These corrections, owing to large amplification factors in going from phase shifts to cross section, may be of some significance in muon scattering, but are probably of no importance in the analysis of high-energy electron scattering. The dynamic effect is proportional to nuclear charge and therefore nearly as great for heavy as for light nuclei. (auth)

12141

NUCLEAR SPECTROSCOPY. I. Perlman (Univ. of California, Berkeley). Proc. Natl. Acad. Sci. U. S. **45**, 461-70(1959) Apr.

Nuclear states in the heavy element region were investigated, and methods for obtaining information from the study of alpha-radioactive substances are discussed. The alpha emission process is analyzed. Spectra, decay schemes, and energy levels are shown graphically for several heavy isotopes. (A.C.)

12142

MESIC CORRECTION TO THE BETA-DECAY IN A NUCLEUS. Jun-Ichi Fujita (Nihon Univ., Tokyo) and Zyun-Itiro Matumoto, Eiichi Kuroboshi, and Hironari Miyazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) **20**, 308-14(1958) Sept.

Mesic corrections to beta decay interactions in a nucleus are investigated. It is found that the Gamow-Teller coupling constant should apparently become about 8% smaller by exchanging pions among nucleons. Also the mesic effect in the l-forbidden case is discussed. (auth)

12143

SPONTANEOUS FISSION HALF-LIVES. Tatuya Sasakawa and Masaru Yasuno (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) **20**, 315-26(1958) Sept.

A dynamical theory of nuclear distortion leading fission, is presented. This theory is based on the unified model (the collective model). But, since spontaneous fission is an irreversible process, the theory is treated reflecting this speciality. Starting from this dynamical

theory, a semi-empirical formula of spontaneous fission half lives of even-even nuclei is derived. This formula can well reproduce the general tendency of spontaneous fission half lives of even-even nuclei. The essential features which affect half lives are discussed. Finally, a reason for the asymmetry character of fission and the orientation in calculating the difference of half lives between even-even and even-odd nuclei are given. (auth)

12144

FIRST EXCITED STATE IN Ca^{42} AND Ca^{44} . Toshiya Komoda (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto) 20, 580-2(1958) Oct.

The $f_{7/2}$ shell Ca isotopes can be interpreted by the jj-coupling shell model. According to this model it is expected that with any form of two-body interaction, the excitation energy of the first excited state should be the same for the case in which there are two particles in the $f_{7/2}$ shell as for the case with four particles in the shell. However, the energies of the first excited state of Ca^{42} and Ca^{44} are experimentally different. To interpret this discrepancy the lower levels of Ca^{42} and Ca^{44} were calculated by using the method of configuration mixing. The analysis of the data in Ca^{42} and the level order of the independent shell model led to the assumption that configurations $(f_{7/2})^2_0$, $(f_{7/2}f_{5/2})_2$, and $(f_{7/2})^2_2$ are intermixed. The calculated values of the energy difference of the first excited states of Ca^{42} and Ca^{44} for the Rosenfeld mixture are tabulated. (A.C.)

12145

ELECTRON PAIR PRODUCTION BY GAMMA RAYS FROM ThD (Pb^{208}). Andrzej Hryniewicz. Zeszyty Nauk. Univ. Jagiel., Ser. Nauk Mat. Przyrod., Mat., Fiz. Chem., [1,] No. 3, 31-64(1955). (Translated from Referat. Zhur. Fiz. No. 9, 1958, Abstract No. 20012.)

Geiger-Mueller counters were used to investigate the angular distribution of electrons produced by gamma rays from Pb^{208} . The results obtained are not in agreement with the angular distribution calculated by the Bethe-Heitler theory. In a second series of measurements, the absorption of electron pairs in aluminum was determined. The experimental curves were compared with the curves obtained on the basis of the energy distribution of the electron in accordance with the Bethe-Heitler and Eger and Holm theories. In the third series of measurements, an investigation was made of the dependence of the effective cross section for the production of electron pairs on Z. The Eger and Holm theory predicts deviations from the square law. For copper and silver, the experiment confirm the Eger and Holm theory. For aluminum, the errors in the measurement are excessive.

12146

STUDY OF THE NUMBER OF NEUTRONS PRODUCED BY THE FISSION OF Pu^{239} . Maurice Jacob. Paris, Gauthier-Villars, 1958. 28p. (In French)

Coincidence counters were used to study the variation of the average number of neutrons produced by fission, ν . At the precision of the measurements made on Pu^{239} , ν is constant in the thermal and epithermal region. The ratio of ν of the fission spectrum to ν of the thermal spectrum is 1.065 ± 0.020 . A relationship between the mean quadratic error and the average number of neutrons produced by fission was established with the aid of two counter groups. For Pu^{239} the distribution law is more restricted than a Poisson law. (tr-auth)

Theory

12147 HW-34021

General Electric Co. [Hanford Atomic Products Operation,] Richland, Wash.

A SUMMARY OF SMALL SOURCE THEORY APPLIED TO THERMAL REACTORS. W. A. Horning. Dec. 6, 1954. Decl. July 18, 1955. 38p. Contract W-31-109-Eng-52. \$6.30(ph), \$3.00(mf) OTS.

A "small source model" for neutron flux distribution in heterogeneous reactors is proposed. Such a model takes more explicit account of fuel lumping than has been customary in most pile calculations. The small source is applied to the cases of plate and rod fuel elements. The chief results are equations which give the pile buckling in terms of the distance between fuel elements and in terms of fuel element constants. (W.D.M.)

12148

THE 13-PARAMETRIC GROUP OF TRANSFORMATIONS OF THE SPINOR SPACE AND ITS REPRESENTATIONS. Jan Rzewuski (Univ. of Wroclaw and Polish Academy of Sciences, Wroclaw, Poland). Acta Phys. Polon. 17, 417-28(1958).

The irreducible representations of a 13-parametric group of transformations of the spinor space are constructed. They include all transformation types assumed so far phenomenologically for the fundamental particles including their isotopic spin characterization. An eight-dimensional real spinor space corresponding to the original four-dimensional complex spinor space is introduced. It is shown that the spinor space provides a common geometrical basis for all conservation laws including charge, isotopic spin and baryon conservation laws. The possible bilinear connections of the spinor space with the conventional space-time are discussed. These connections enable one to introduce inversions and to derive the connection between the differential equations in both spaces. (auth)

12149

TWO THEOREMS CONCERNING THE FIELD EQUATIONS IN THE SPINOR SPACE. J. Rzewuski (Polish Academy of Sciences, Wrocław, Poland and Wrocław Univ., Poland). Bull. acad. polon. sci. Sér. sci. math. astron. et phys. 6, 335-41(1958).

The connection between the invariant first- and second-order differential operation in both spaces was obtained. It was found that the spinor space offers a greater variety of differential equations than the vector space. (R.V.J.)

12150

CHARGE DISTRIBUTION OF THE NUCLEON IN THE THEORY OF THE FIXED SOURCE. Madeleine Collin. Compt. rend. 248, 1793-5(1959) Mar. 23. (In French)

The terms of the expression derived by Fubini (Nuovo cimento 3, 764(1956)) for the charge spatial density $\rho(r)$ were calculated. The results showed that the diffusion correction term has little effect on experimental magnitudes such as the form factor, mean quadratic radius, and the electron-neutron interaction. The static theory therefore does not consider satisfactorily the experimental results on the neutron and proton taken either as two aspects of the "nucleon" or separately. (J.S.R.)

12151

NUCLEAR MATRIX ELEMENTS FOR SOME 1^{π} -FORBIDDEN UNIQUE β TRANSITIONS. B. Oquidam and

B. Jancovici (Ecole Normale Supérieure, Paris). Nuovo cimento (10) **11**, 578-88(1959) Feb. 16.

The nuclear matrix elements for first-order forbidden unique β transitions, in the mass number region around $A = 40$, were studied within the framework of the shell model. The analysis of the experimental results permits the experimental matrix elements to be obtained. Then the matrix elements are calculated, first with the simple model in which the angular moments of the proton group and the neutron group are separately good quantum numbers, and then with a more complicated model. The results of the second model are in good agreement with experimental results for the relative values of the matrix elements. A systematic variation is obtained for the absolute values. The study of analogous γ transitions permits the variations, at least for the most part, to be attributed to the effects of nuclear structure. (tr-auth)

12152

A GENERAL TRANSFORMATION OF THE SYMMETRICAL PSEUDOSCALAR THEORY. A. Pais (Institute for Advanced Study, Princeton, N. J.) and R. Serber (Columbia Univ., New York). Phys. Rev. **113**, 955-8 (1959) Feb. 1.

The symmetrical pseudoscalar theory with extended source is subjected to a rigorous transformation in such a way that the transformed Hamiltonian depends explicitly on the total isotopic spin and total angular momentum of the system. These collective variables are introduced by the same method of employing a general distribution function which was previously studied by the authors for the charged scalar theory. (auth)

12153

ELECTRON SCATTERING CROSS SECTION WITH RELATIVISTIC CORRECTION BASED ON THE THOMAS-FERMI THEORY. T. Tietz (Univ. of Łódź, Poland). Phys. Rev. **113**, 1056-7(1959) Feb. 15.

A formula for the total cross section for elastic scattering of fast electrons by a Thomas-Fermi potential, including relativistic effects, is derived from the differential cross section previously obtained. (auth)

12154

REACTOR CRITICALITY IN TRANSPORT THEORY. Garrett Birkhoff (Harvard Univ., Cambridge, Mass.). Proc. Natl. Acad. Sci. U. S. **45**, 567-70(1959) Apr.

Recent work has indicated increasingly that in nuclear theory the mathematical concepts of critical neutron distribution, effective multiplication factor K , and importance function depend essentially on the positivity of the multiplicative process relating successive events in random neutron histories. This has already been demonstrated in both the discrete and continuous multi-group approximation. A proof is sketched of the same principle in the context of neutron transport theory. (A.C.)

12155

ON THE CONCEPT OF POTENTIAL IN QUANTUM FIELD THEORY. Abraham Klein (Univ. of Pennsylvania, Philadelphia). Progr. Theoret. Phys. (Kyoto), **20**, 257-66(1958) Sept.

The literature contains two forms of the two-nucleon potential computed to fourth order in the coupling constant from the gradient coupling of the π meson to the nucleon field. These are commonly referred to as the

Taketani-Machida-Onuma (T.M.O.) and the Brueckner-Watson (B.W.) potentials. The merits of the controversy surrounding this schism are re-examined from first principles starting from the covariant equation for two nucleons, and it is concluded that the conditions for the applicability of the method leading to the T.M.O. potential are never satisfied in practice. On the other hand, the B.W. potential, suitably altered following recent suggestions by Miyazawa and the author, may well yield a suitable approximation in the low-energy region. (auth)

12156

A COMPARISON OF PLANE WAVE SOLUTIONS IN GENERAL RELATIVITY WITH THOSE IN NON-SYMMETRIC THEORY. Hyōtirō Takeno (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto) **20**, 267-76(1958) Sept.

Exact plane wave solutions of the field equations in general relativity and those of the field equations in nonsymmetric unified field theory are obtained under similar conditions for the case in which electromagnetic fields are present. Main properties of both solutions are compared with each other. The most important result is that, as far as the solutions dealt with are concerned, the space-time is closely connected with the electromagnetic field in general relativity, while in nonsymmetric unified field theory the structure of the Riemannian space-time is determined quite independently of the electromagnetic field. (auth)

12157

EFFECT OF NON-RELATIVISTIC RECOIL OF A SOURCE PARTICLE IN QUANTUM FIELD THEORIES. Jun'ichi Osada and Haruyuki Fukino (Tokyo Inst. of Tech. and Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto) **20**, 487-504(1958) Oct.

A convenient calculation method is developed for the treatment of polaron-like systems, that is, the systems of a quantized field and a non-relativistically moving particle which are interacting fairly strongly with each other. Firstly, generalizing the Chew-Low method, a set of equations is constructed by which the effect of the recoil of a source-particle on the scattering amplitudes can be directly calculated. A formula for the effective mass of the particle is also given. Then, four problems are solved as examples. The first two are the scattering of neutral scalar meson and the effective mass of the polaron. Though these have already been solved, they are investigated in order to explain and justify the approximation method. The other two are the P-wave scattering of the charged scalar meson and the pair-theory meson. Finally, the importance of the non-relativistic recoil is discussed. (auth)

12158

EXTENSIVE AIR SHOWERS. William Galbraith. New York, Academic Press Inc., 1958. 223p.

The primary concern in this work is with those incoming particles of greatest energy in the cosmic radiation. An account is presented of the work in this field which has been carried out over the last twenty years since the discovery of the phenomena of extensive air showers. The book is intended for physics students and graduates. (W.D.M.)

12159

ANGULAR MOMENTUM IN QUANTUM MECHANICS. A. R. Edmonds. Princeton, N. J., Princeton University Press, 1957. 149p.

A very general theory of angular momentum algebra

is developed from which can be derived computational methods applicable to problems in such fields as atomic, molecular, and nuclear spectroscopy, nuclear reactions, and the angular correlation of successive radiations from nuclei. Questions of notation and phase convention are considered and tables of formulas and references to numerical compilations are included to facilitate the evaluation of the various coefficients defined in the text. A general knowledge of quantum mechanics is assumed. (W.D.M.)

RADIATION EFFECTS ON MATERIALS

12160 AAEC/E-6

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. GROWTH OF BERYLLIUM UNDER IRRADIATION. K. F. Alder. Feb. 1956. 10p.

The results of a calculation estimating the rate of swelling of beryllium metal by the formation of bubbles of helium gas due to irradiation are reported. (auth)

12161 APEX-462

American Nuclear Science Corp., New York. THE EFFECT OF REACTOR RADIATION AND TEMPERATURE ON SILICON JUNCTION DIODES. A. Friedman, L. M. Slater, H. K. Alan Kan, and L. M. Sharpe. Feb. 1959. 173p. To General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33(600)-38062 and AT(11-1)-171. \$3.00(OTS).

The effects of high temperature (up to 300°C) and reactor radiation on silicon junction diode forward and reverse characteristics, switching characteristics, noise, Zener voltage, and Zener slope characteristics were measured using three positions in the BNL Reactor. Eleven types of commercial silicon junction diodes were irradiated. The response to irradiation was found to vary greatly among diodes even of the same type. (W.D.M.)

12162 APEX-477

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. RADIATION AND TEMPERATURE TESTS OF MINATURE TRANSISTOR AMPLIFIERS. J. E. Mott. May 1959. 32p. Contracts AF33(600)-38062 and AT(11-1)-171. \$1.00(OTS).

The results of radiation and temperature tests run on two different types of miniature transistor amplifiers are presented. Performance curves are shown, and an analysis of the results leading to a possible method of failure prediction is given. One of the amplifier types was successfully tested to a temperature of 150°C, gamma irradiation of 4.7×10^7 roentgens, and a fast neutron dosage of 7.0×10^{13} nvt (epicadmium). These results place the use of such an amplifier within the realm of feasibility as an airframe-mounted control component. (auth)

12163 NAA-SR-Memo-1214

North American Aviation, Inc., Downey, Calif. THE RADIATION AND THERMAL STABILITY OF ORTHO-, META-, AND PARA-TERPHENYLS. E. L. Colichman, R. H. Gercke, and R. Fish. Dec. 20, 1954. Decl. Nov. 6, 1958. 21p. \$4.80(ph), \$2.70(mf) OTS.

The rate of damage to terphenyls at reactor temperatures was assessed using 1-Mev electrons. Results are presented in terms of G values which are given graphically. Photographs of equipment are included. (J.R.D.)

12164 NP-7365(Vol. 1)

Lockheed Nuclear Products, Marietta, Ga. THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 177p. (NR-51(Vol. 1)).

Ten papers on subjects of general interest in the ANP program are presented. (W.D.M.)

12165 NP-7365(Vol. 1)(Paper 1)

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

APPLICATION OF RADIATION EFFECTS DATA TO DESIGN AND DEVELOPMENT PROBLEMS. C. G. Collins. Paper 1 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1: GENERAL SESSION PAPERS. 18p.

A summary is presented of the concepts and procedures utilized in applying radiation effects data to the solution of design problems and comments on developments of the past year. Conceptually, application of radiation effects data involves the comparison of observed effects on materials properties with the requirements of the anticipated application. Following a description of the over-all procedure, the bases, limitations, and recent developments in the steps are reviewed. The discussion is limited to organic materials. (W.D.M.)

12166 NP-7365(Vol. 1)(Paper 2)

Lockheed Nuclear Products, Marietta, Ga. RADIATION EFFECTS TESTING OF AIRCRAFT SUBSYSTEMS AND COMPONENTS AT AIR FORCE PLANT NO. 67 FOR THE ANP PROGRAM. W. L. Bridges. Paper 2 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 12p.

A few of the features of Air Force Plant No. 67 are briefly reviewed as they contribute to a discussion of the philosophy of radiation effects testing of aircraft subsystems and components. The major functions of this facility will be to irradiate, test, and evaluate aircraft components and complete subsystems under dynamic environmental conditions. (W.D.M.)

12167 NP-7365(Vol. 1)(Paper 4)

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif. and General Electric Co. General Engineering Lab., Schenectady, N. Y. NEW RADIATION TEST FACILITIES IN THE GENERAL ELECTRIC COMPANY. S. S. Jones, W. R. Langdon, and T. T. Naydan. Paper 4 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 32p.

New radiation test facilities in operation or being installed by General Electric at Schenectady and Pleasanton are described. The facilities at Schenectady include a 15,000 curie gamma source, a 1 Mev and a 10 kw electron accelerator, and a 1 Mev and a 10 kw ion accelerator. Facilities at Vallecitos Atomic Laboratory for irradiation and testing of materials, components, and systems include the 30 Mw GE Test Reactor, the 30 Mw Vallecitos Boiling Water Reactor, a 30 kw Nuclear Test Reactor, complete hot cell services, and versatile gamma irradiation facilities. (W.D.M.)

12168 NP-7365(Vol. 1)(Paper 5)

Convair, Fort Worth, Tex. THE CONVAIR RADIATION EFFECTS TESTING SYS-

TEM. J. W. Allen. Paper 5 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME I. GENERAL SESSION PAPERS. 11p. (FZM-1153).

The radiation effects testing system at Convair-Fort Worth, including the shuttle system to transport specimens in special environmental chambers, is described. The hardware and controls necessary to meet the environmental criteria and the versatility of the system are discussed. Construction progress on the system is summarized. (W.D.M.)

12169 NP-7365(Vol. 1)(Paper 6)

Lockheed Nuclear Products, Marietta, Ga.

RADIATION EFFECTS REACTOR. W. T. Scarborough. Paper 6 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 10p.

The Radiation Effects Reactor is a 10-megawatt, pressurized, heterogeneous, light water cooled and moderated reactor, using fully enriched uranium in ETR type elements. It is mounted on a hydraulic lift, which raises it from the pool to the height of the systems mounted on railroad cars around the pool for irradiation. Coolant flows through swivel pipes at 3000 gpm. Control and instrumentation cables are routed through an overhead conveyor system to lessen radiation damage to them. A new core will contain 11.6% Δk excess reactivity and have a lifetime of 7000 megawatt hours at rated power. Calculated flux values at the pressure vessel surface are thermal neutron current -3×10^7 nv, above thermal neutron current -8×10^6 nv, and gamma flux -6×10^{13} Mev/cm²-sec. (auth)

12170 NP-7365(Vol. 1)(Paper 7)

Inland Testing Labs., Morton Grove, Ill. and Cook Electric Co. Cook Research Labs. Div., Morton Grove, Ill.

A DESCRIPTION OF A MULTI-KILOCURIE IRRADIATION FACILITY AND THE ASSOCIATED RADIATION DOSIMETRY. R. E. Simpson, M. Z. Fainman, M. E. Krasnow, E. R. Rathbun, and C. R. Memhardt. Paper 7 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 30p.

Inland Testing Laboratories has designed, constructed, and is operating a 50,000 curie Co⁶⁰ irradiation facility which produces a dose rate of 10^6 r/hr. Developmental research is described regarding the design of the source configuration, the albedo characteristics of the cave, the assay and total activity of the source as measured by a graphite ionization chamber, and the assembly and isodose plot of the completed source. (W.D.M.)

12171 NP-7365(Vol. 1)(Paper 8)

Lockheed Nuclear Products, Marietta, Ga.

START-UP OF THE CRITICAL EXPERIMENT REACTOR. M. A. Dewar. Paper 8 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 16p.

The Critical Experiment Reactor operated at Air Force Plant No. 67 by Lockheed Nuclear Products Branch is used to establish core loadings for the Radiation Effects Reactor and to determine all pertinent nuclear characteristics of each RER core. Criticality was

achieved June 9, 1958, with a rectangular 20-element array containing approximately 3.260 kg U-235 and having approximately 0.3% excess reactivity. The four fuel-poison control rods were determined to have a shutdown worth of approximately $4\frac{1}{2}\%$ $\Delta k/k$ each. The silver-cadmium regulating rod is worth approximately 0.3% $\Delta k/k$ negative reactivity. The RER operational loading, containing 11.6% reactivity, was achieved in the CER with a 32-element array, approximately 5.372 kg U-235. For this core the temperature coefficient is negative, approximately -7.01×10^{-5} $\Delta k/k$ per °C at 75°F. The void coefficient is approximately -4.35×10^{-4} $\Delta k/k$ percent void. The critical and operational core loadings, rod worth, and coefficient values were in good agreement with previously calculated values. (auth)

12172 NP-7365(Vol. 1)(Paper 9)

Lockheed Nuclear Products, Marietta, Ga.

REMOTE AREA MONITORING SYSTEM AT AIR FORCE PLANT NO. 67. E. N. Lide. Paper 9 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 8p.

To conform to Air Force Plant No. 67 facility requirements for the capability of rapidly irradiating large numbers of test articles, including aircraft subsystems in operation, the Radiation Effects Reactor operates above ground with essentially no shielding. This condition necessitates the monitoring of neutron and gamma flux levels at selected stations of the site and at the perimeter during reactor operation. A remotely operated radiological monitor system was developed for this purpose. The functions of this system are to supply primary power to the remote detectors and instrumentation, sequentially select the type of radiation to be monitored, and provide a means of conducting the radiation analog currents back to the central station for recording and for identifying the radiation type and originating station. (auth)

12173 NP-7365(Vol. 1)(Paper 10)

Lockheed Nuclear Products, Marietta, Ga.

AREA MONITORING FOR RADIOACTIVITY. Roy Shipp. Paper 10 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 8p.

To ensure the safety of people in the general vicinity of the Radiation Effects Reactor, monitor stations are situated around the exclusion fence to provide readings for use in controlling radiological hazards. Factors monitored include concentration of Ar⁴¹, as well as fast neutrons and gamma intensities. Development of detectors and certain aspects of the Ar⁴¹ problem are covered. (W.D.M.)

12174 NP-7365(Vol. 1)(Paper 11)

Lockheed Nuclear Products, Marietta, Ga.

LOGARITHMIC CIRCUITS FOR RADIATION DOSIMETRY. L. A. Turner. Paper 11 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 1. GENERAL SESSION PAPERS. 8p.

Logarithmic circuits for use in flux mapping and subsystems testing at Air Force Plant No. 67 are described. Simple circuits are available for the logarithmic measurement of a-c and d-c voltages and frequencies or pulse repetition rates. Ranges of over 100 db are easily obtained. (W.D.M.)

12175 NP-7365(Vol. 2)

Lockheed Nuclear Products, Marietta, Ga.
THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958.
VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 203p. (NR-51(Vol. 2)).

Ten papers on dosimetry and nuclear measurements are presented. The papers represent the unclassified topics from the second session. (W.D.M.)

12176 NP-7365(Vol. 2)(Paper 12)

Oak Ridge National Lab., Tenn.
INFLUENCE OF ENERGY SPECTRA ON RADIATION EFFECTS. F. C. Maienschein. Paper 12 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958.
VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 31p.

The energy spectra of neutrons and gamma rays influence in an important way the production of displacements in crystal lattices. A lack of knowledge of the energy distributions in many past and current reactor irradiations for radiation "effect" studies has led to the accumulation of relatively meaningless data. Special problems arise in attempting to compare data taken at different types of reactors with unknown energy spectra. The available data for reactor spectra are listed and examples given. Methods of spectroscopy are considered briefly which may be useful for developing further spectral data. Finally, the merits are examined of several possible characterizations of a radiation field which are simpler to obtain than the energy spectrum. Comparison of these parameters with those commonly used now shows that the new parameters would constitute a marked improvement in understanding and correlating radiation effects. (auth)

12177 NP-7365(Vol. 2)(Paper 13)

Ohio State Univ., Columbus.
AVERAGE NEUTRON CROSS SECTIONS FOR TYPICAL REACTOR SPECTRA. Walter R. Burrus and Russell P. Sullivan. Paper 13 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 16p.

Average neutron cross sections are calculated for fifteen common elements. Elastic scattering, inelastic scattering, and charged particle reactions are considered. From these average cross sections, one may calculate a dose in one material from a measured dose in another or one may calculate a dose from an activation, an activation from a dose, or an activation from an activation. The spectra used for calculating the averages are for fission neutrons which have penetrated various thicknesses of water and graphite. The relationship of the calculated averages to other types of averages is discussed and conversion factors are given. Cross section averages are also given for several fission foils. The fraction of the absorbed dose which is transferred to recoil nuclei which does not result in ionization is calculated for five elements. This fraction is useful in comparing radiation effects which are caused by atomic displacements. (auth)

12178 NP-7365(Vol. 2)(Paper 14)

National Bureau of Standards, Washington, D. C.
NUCLEAR RADIATION UNITS AND MEASUREMENTS. R. S. Caswell and S. W. Smith. Paper 14 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM

[HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 25p.

12179 NP-7365(Vol. 2)(Paper 15)

Ohio State Univ., Columbus and Lockheed Aircraft Corp. Missile Systems Div., [Palo Alto, Calif.].
COMPARISON OF RADIATION EFFECTS IN DIFFERENT FACILITIES. W. R. Burrus and W. T. Harper. Paper 15 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 22p.

Regardless of any agreement reached on units and methods of measurement within the Nuclear Propelled Manned Aircraft Program, there still exists the problem of correlating the radiation-effects data reported by investigators in agencies that are not participating in the Program. To cope with this problem, a simplified method for consistent comparison of the data obtained in different facilities is presented. This is accomplished by expressing radiation environments in terms of "carbon-absorbed gamma dose" and "water-absorbed neutron dose." Although the method involves some simplifying assumptions and approximations, it is shown to be generally applicable to organic materials, which cause some of the most critical problems for the designer of nuclear-propelled aircraft. The sample calculations, tables, and curves presented may be used as a handbook for conversion of radiation dose data to common denominators. Such conversions permit comparison of data even when information on the spectral distribution of the radiation environment is lacking. (auth)

12180 NP-7365(Vol. 2)(Paper 16)

Convair, Fort Worth, Tex.
THE DETERMINATION OF NUCLEAR PARAMETERS FOR EXPERIMENTAL RADIATION EFFECTS. G. A. Wheeler. Paper 16 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 8p.

Necessity for knowledge of radiation field is discussed. Current dosimetry techniques in use at Convair are presented together with the differences between present "state-of-the-art" and desired measurements. The magnitude of the difficulties encountered in Convair's mapping of the GTR field are detailed. (auth)

12181 NP-7365(Vol. 2)(Paper 17)

Lockheed Nuclear Products, Marietta, Ga.
CALORIMETRIC DOSIMETRY PROGRAM AT LOCKHEED. Rober L. Gamble. Paper 17 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 14p.

To measure energy deposition in organic materials, low-cost calorimetric radimeters of both the adiabatic and steady-state types were designed. The ranges of these instruments are from 5×10^4 rads per hour to 10^7 rads per hour. The radimeters consist of a right circular cylinder of solid polystyrene two inches in diameter and one inch thick, placed inside a 10-inch cube of styrofoam. (W.D.M.)

12182 NP-7365(Vol. 2)(Paper 19)

Bell Telephone Labs., Inc., Whippany, N. J.
NEUTRON FLUX ENERGY DISTRIBUTION OF THE BNL REACTOR SHIELDING FACILITY. M. M.

Donnelly and M. M. Weiss. Paper 19 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 15p. Contract AF33(600)-32662.

A study was made to determine the neutron flux energy distribution of the BNL reactor shielding facility employed in the semiconductor radiation damage studies by Bell Telephone Laboratories. This facility offers an opportunity for a critical comparison between the mathematical methods available to compute the fast flux and the experimental methods using foil activation techniques. The methods and equipment used and the results obtained are described. The major effort of flux distribution measurement was in the energy range from 0.1 to 10 Mev. (auth)

12183 NP-7365 (Vol. 2) (Paper 20)

General Electric Co. Specialty Transformer Dept., Fort Wayne, Ind. and General Electric Co. General Engineering Lab., Schenectady, N. Y.

THE EFFECTS OF NUCLEAR RADIATION ON SPARK GAPS. G. I. Duncan, J. C. Fraser, and B. Valachovic. Paper 20 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 19p. Contract AF33(616)-5579.

The General Electric Company has completed a program covering the testing of spark gaps in the Brookhaven National Laboratory's graphite reactor. It consisted of a two-week in-pile exposure designed to investigate the voltage breakdown strength of air at various pressures in the presence of the following radiation levels: 1×10^{11} fast neutrons/cm² sec, 2×10^{12} thermal neutrons/cm² sec, and 1×10^{12} gamma photons/cm² sec. The components tested, the test equipment and circuitry, and the dynamic pressure system used are described. Curves are presented showing the effects noted, and the results of the tests are summarized. (auth)

12184 NP-7365 (Vol. 2) (Paper 21)

Mallory (P.R.) and Co., Inc., Indianapolis. RADIATION TESTING AND PROPERTIES OF A BORON NITRIDE DIELECTRIC CAPACITOR. G. R. Van Houten, T. C. O'Nan, and J. T. Hood. Paper 21 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 2. DOSIMETRY AND NUCLEAR MEASUREMENTS PAPERS. 39p.

The development program for a 3 μ f, 3000 v, 12 joule jet engine ignition capacitor for operation from -65 to +500°C is described. Tests to date include a study of boron nitride powders and compacts in a reactor environment, fabrication and testing of capacitor bodies from reactor irradiated boron nitride, and operational testing of boron nitride capacitors in a high gamma environment. The tests are described in detail, and significant results are given. (W.D.M.)

12185 NP-7365 (Vol. 3)

Lockheed Nuclear Products, Marietta, Ga. THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 177p. (NR-51 (Vol. 3)).

Eleven papers are presented on aircraft systems and materials from the third session of the symposium.

The classified papers from all the sessions were bound in volume six. (W.D.M.)

12186 NP-7365 (Vol. 3) (Paper 22)

Convair, Fort Worth, Tex.

PREDICTING THE PERFORMANCE OF IRRADIATED ELECTRONICS SYSTEMS BY SIMULATION ON THE ANALOG COMPUTER. V. C. Brown and N. M. Peterson. Paper 22 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 15p. (FZM-1159).

The method of simulating electronic systems on analog computers for the purpose of studying the effects of radiation is described, and a comparison is made between the results obtained by the simulation technique and data obtained in an actual irradiation. The results show that, by combining proper statistical methods with computer simulation, the performance of electronics systems under radiation may be successfully predicted. (auth)

12187 NP-7365 (Vol. 3) (Paper 23)

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

COMBINED TIME, TEMPERATURE, AND RADIATION EFFECTS ON ORGANIC MATERIALS. C. G. Collins. Paper 23 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 16p.

Experimental observations of combined time, temperature, and radiation effects on a lubricating oil and Teflon aircraft engine hoses are described for the temperature range from 80 to 400°F and for radiation rates of 10^6 to 5×10^7 ergs (gc)⁻¹ hr⁻¹. The results show that at a constant radiation rate the failure time—as judged by the oxidation-induction period of the oil and by leaks in the Teflon hoses—follows an Arrhenius-type relationship with temperature. At a constant temperature, failure time was found to follow a logarithmic relationship with radiation dose rate. The over-all results can be described in a summary equation in terms of time, absolute temperature, and radiation dose rate. Several implications of the summary equation are discussed in reference to radiation effects in organic materials. One implication is that observations of equal damage at constant dosage irrespective of dose rate may be valid at only one temperature or at high dose rates. (auth)

12188 NP-7365 (Vol. 3) (Paper 24)

Goodyear Tire and Rubber Co., Akron, Ohio.

RADIATION DAMAGE OF AIRPLANE TIRE MATERIALS. T. C. Gregson and S. D. Gehman. Paper 24 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 25p.

Damage to tire components typical of present production was studied with Co⁶⁰ gamma radiation. The influence of various environmental factors was also investigated. Tire fabric and fabric-rubber adhesion are far more susceptible to radiation damage than are the rubber compounds in general use. Cord fatigue and dynamic adhesion are the most serious aspects of radiation damage to tires. Various types of nylon tire cords possess significant differences in their ability to withstand irradiation. Several nitrogen inflated tires were exposed to a dose of 10^7 rad, a level above the damage threshold for nylon cords when irradiated in air. Their

performance in laboratory tests confirmed the protective benefits of nitrogen inflation. (auth)

12189 NP-7365(Vol. 3)(Paper 25)

Lockheed Aircraft Corp., Marietta, Ga.

RADIATION EFFECTS ON FLIGHT CONTROL SUBSYSTEM DESIGN. D. O. Gunson. Paper 25 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958.

VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 8p.

Successful application of nuclear propulsion to aircraft requires the development of a high-performance flight control subsystem that is not only more reliable, serviceable, and maintainable than the best flying today but is at least as efficient while operating in a radiation environment. The attainment of these aims demand close and continued cooperation between the radiation effects specialist and controls designer throughout the design, development, and testing of this subsystem. The basic problems considered are: the establishment of the important characteristics of a flight control subsystem, how radiation environment affects these characteristics, and the type of radiation effects data required by the controls designer. (auth)

12190 NP-7365(Vol. 3)(Paper 26)

Lockheed Aircraft Corp., Marietta, Ga.

PNEUMATICS—A TOOL FOR THE DESIGNER OF NUCLEAR POWERED AIRCRAFT. J. A. Osterman.

Paper 26 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 6p.

Pneumatics has been demonstrated to have promise in the field of high temperature aircraft system operation. Air has greater resistance to nuclear radiation and is capable of operating over a wider range and higher temperatures than any available hydraulic fluid. The essential results are given of a program of study of a high temperature pneumatic system which offers a promising tool to the nuclear aircraft system designer. (auth)

12191 NP-7365(Vol. 3)(Paper 27)

Lockheed Nuclear Products, Marietta, Ga.

AIRCRAFT RADOME DESIGN PROBLEMS ASSOCIATED WITH A NUCLEAR ENVIRONMENT. Frank W. Thomas. Paper 27 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 18p.

The effects of nuclear radiations in relation to microwave transmission through a dielectric lens, or radome, presents a number of design problems associated with nuclear-powered aircraft. A mathematical prediction technique was used to estimate the effect of radiation on multilayer dielectric flat panels. The results show how radiation effects data may be interpreted in the design of a radome test panel. (auth)

12192 NP-7365(Vol. 3)(Paper 30)

Raytheon Mfg. Co., Waltham, Mass.

ON THE ENERGY LEVELS IN NEUTRON-IRRADIATED P-TYPE SILICON. C. A. Klein and W. D. Straub.

Paper 30 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 29p.

High-resistivity p-type silicon samples were irradiated in the Brookhaven pile for short periods of time re-

sulting in integrated fast neutron fluxes of the order of a few 10^{14} n/cm². Hall coefficient and conductivity measurements were then performed over extended temperature ranges. A detailed analytical investigation of these data provides evidence for at least two bombardment-induced hole trap levels in the lower half of the energy gap. The deep trap, at 0.29 ev from the valence band, is introduced at a rate which appears to be proportional to the integrated flux. Moreover, it has been established that for this level the product of the statistical weight factor by the temperature shift factor, as defined below, is practically equal to one. The shallow trap, at 0.16 ev from the valence band, is not yet as fully describable. (auth)

12193 NP-7365(Vol. 3)(Paper 31)

Convair, Fort Worth, Tex.

EFFECT OF RADIATION ON THE CRITICAL SHEAR STRESS OF A METAL SINGLE CRYSTAL. C. E. Morgan. Paper 31 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 10p.

A mechanism is postulated to account for the radiation hardening of a metal single crystal. The mechanism is based on a lattice defect consisting of interlocking dislocation rings. According to this model, the critical shear stress of a metal single crystal varies as the cube root of the integrated fast neutron flux. This agrees well with the results of experiments by Blewitt et al. on irradiated high-purity copper crystals. (auth)

12194 NP-7365(Vol. 3)(Paper 32)

General Atomic Div., General Dynamics Corp., San Diego, Calif.

MEASUREMENT OF THE RANGE OF RECOIL ATOMS. R. A. Schmitt and R. A. Sharp. Paper 32 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 9p.

An important problem in the interpretation of radiation damage and sputtering phenomena is the evaluation of the range of an atom which moves through a lattice after having received an initial energy of 10 to 100 kev. An experiment is described in which atoms with initial energies in this range were produced by irradiating suitable targets with high-energy bremsstrahlung gamma rays, and the products of photonuclear reactions, such as photoneutron (γ, n) transmutations, were observed. The photon spectrum of the gamma rays was continuous from 0 to 24 Mev. The energy spectra of evaporated neutrons were centered at about 1.5 Mev. (W.D.M.)

12195 NP-7365(Vol. 3)(Paper 33)

Naval Research Lab., Washington, D. C.

THE EFFECTS OF NUCLEAR IRRADIATION ON METALLIC AND NONMETALLIC MAGNETIC MATERIALS. E. I. Salkovitz, A. I. Schindler, and G. S. Ansell. Paper 33 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 3. AIRCRAFT SYSTEMS AND MATERIALS PAPERS. 23p.

Extensive investigations of the effects of nuclear environments upon magnetic materials were undertaken. A major aim of the program was to obtain basic information concerning the mechanisms producing the observed effects. More than 100 samples were irradiated in the Brookhaven graphite reactor at an integrated flux of 10^{17} NVT. The materials studied were in the form of

toroids or rods and consisted mainly of various ferrites and square loop and high permeability alloys. In addition, discs of permanent-magnet type ferrites and portions of magnetic devices were irradiated. A detailed discussion is given of the method of canning temperature control, and the means by which pre- and post-irradiation magnetic measurements were made. (auth)

12196 NP-7365(Vol. 4)

Lockheed Nuclear Products, Marietta, Ga.

THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 311p. (NR-51(Vol. 4)).

Thirteen papers are presented on the radiation effects in semiconductor and electronic equipment. (W.D.M.)

12197 NP-7365(Vol. 4)(Paper 37)

Admiral Corp., Chicago.

THE EFFECTS OF RADIATION ON VARIOUS RESISTOR TYPES. E. R. Pfaff and R. D. Shelton. Paper 37 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 16p.

A study of the effect of nuclear radiation on various types of resistors revealed interesting trends and several possible damage mechanisms, most of which seem to be associated with the boron content in the components. Film-type resistors consisting of a glass core containing boron and a conducting film with no boron showed greater damage when the film was thin. It is probable that in this case the (n, α) reaction in boron removed some of the atoms from the thin conducting film. Resistors having a core with no boron but with a boron-carbon conducting film showed greater damage when the film was thick. It is conjectured that since, in this case, all of the boron is in the conducting film, there is more recoil energy deposited in the conducting layer having the thicker film. Wire-wound resistors having a vitreous enamel coating had resistance changes greater than could be attributed to temperature coefficient or a change from a disordered to ordered arrangement in the wire. There is some evidence that the vitreous coating, sometimes containing a large amount of boron, changes density sufficiently to distort the wire and increase the resistance of the unit by as much as 6 percent. (auth)

12198 NP-7365(Vol. 4)(Paper 38)

Battelle Memorial Inst., Columbus, Ohio.

RADIATION EFFECTS IN COMPOUND SEMICONDUCTORS. L. W. Aukerman and R. K. Willardson. Paper 38 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 20p. Contract AF33(616)-3747.

The properties of semiconductor devices depend strongly on minority-carrier lifetime, carrier concentration, and mobility. These parameters are strongly affected by nuclear irradiation. For the design of a device relatively insensitive to radiation damage, semiconductors composed of heavy atoms and having a high minority-carrier mobility and a large energy gap are desirable. The properties of several compound semiconductors, including AlSb, InP, GaAs, CdTe, and InSb, are compared with respect to the above criteria. Investigations of the effects of fast-neutron irradiation on these compounds are reported. Annealing and heat-

treatment studies before and after irradiation are discussed. (auth)

12199 NP-7365(Vol. 4)(Paper 39)

Lockheed Aircraft Corp. Missile Systems Div., Palo Alto, Calif.

A CRITICAL SURVEY OF RADIATION DAMAGE TO CIRCUITS. W. W. Happ and S. R. Hawkins. Paper 39 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 36p. (LMSD-5011).

A critical survey was undertaken to investigate factors affecting circuit performance in the presence of damage producing radiations. Experimental work in progress consists of irradiating several types of circuits, such as multivibrators and blocking oscillators by gamma radiation with a 100-curie cobalt-60 source. Causes of failure of the circuits tested thus far were traced primarily to the deterioration of semiconductor devices. This preliminary work is being used as a basis for planning investigations of other selected circuits, both under gamma and neutron irradiation. (auth)

12200 NP-7365(Vol. 4)(Paper 40)

Lockheed Aircraft Corp. Missile Systems Div., Sunnyvale, Calif.

RADIATION STABILIZATION OF TRANSISTOR CIRCUITS BY ACTIVE FEEDBACK. S. R. Hawkins and W. W. Happ. Paper 40 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 26p. (LMSD-5031).

The simultaneous deterioration of similar transistors due to radiation damage is employed to stabilize circuit characteristics by using one transistor as a feedback element. The relative merits of a number of circuit configurations are examined on the basis of over-all current and voltage amplification, battery requirements, transistor symmetry, and similar factors. The requirements of both stabilization and amplification are simultaneously satisfied for the common-emitter configuration using a transistor in the common-collector configuration as a feedback element. Design curves for this configuration are given for typical cases to illustrate the usefulness of this method of stabilization. Operating point stabilization is briefly discussed. (auth)

12201 NP-7365(Vol. 4)(Paper 41)

Bell Telephone Labs., Inc., Whippany, N. J.

COMPARISON OF NEUTRON DAMAGE IN GERMANIUM AND SILICON TRANSISTORS. J. W. Easley. Paper 41 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 18p. Contract AF33(600)-32662.

Quantitative comparison of the neutron bombardment sensitivity of germanium transistors to that of silicon transistors must include consideration of the mean time for minority carriers to traverse the base region of the structures being compared. Analysis shows that, for transistors of comparable carrier-transport-factor frequency cutoff, germanium transistors should be capable of receiving fast-neutron exposures which are one to two orders of magnitude greater than those permissible for silicon devices before current-gain degradation becomes critical for typical circuit applications. Experimental data are presented for both germanium and sili-

con transistors which are in good agreement with the analysis. (auth)

12202 NP-7365(Vol. 4)(Paper 43)

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

THE EFFECT OF VARIATION OF THE WIDTH OF THE BASE REGION ON THE RADIATION TOLERANCE OF SILICON DIODES. Gerald C. Huth. Paper 43 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 26p.

Results are presented of experiments which were conducted to determine the effect of varying the width of the base region of a silicon diode on the radiation tolerance of the device as gaged by increase in voltage drop at forward bias. Reasonable agreement is shown between experimentally determined change in forward characteristic and behavior predicted from theoretical considerations—specifically considering the effect of degraded minority carrier lifetime. Devices irradiated were of the alloy junction type based on the configuration of the General Electric IN-538 rectifier. Their over-all behavior is discussed including the near exponential increase found in forward voltage drop, and the retention of reasonable reverse characteristics of all units during irradiation. (auth)

12203 NP-7365(Vol. 4)(Paper 44)

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

THE EFFECT OF NUCLEAR RADIATION ON COMMERCIAL SILICON DIODES. John R. Crittenden. Paper 44 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 14p.

Several types of commercial silicon diodes were irradiated to 10^{16} nvt ($E_n > 0.58$ ev) in the Brookhaven Reactor at 25 and 150°C. The forward and reverse characteristics of each diode were photographed periodically from an oscillographic display during the irradiation period. Noise and switching time measurements were also accomplished. The results of this work indicate that electrically similar diodes vary in their response to nuclear radiation and that the response to nuclear radiation is temperature dependent. (auth)

12204 NP-7365(Vol. 4)(Paper 45)

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

EVALUATION OF SILICON DIODE IRRADIATION RESULTS IN TERMS OF MAGNETIC AMPLIFIER PERFORMANCE. Jack A. Russell. Paper 45 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 52p.

Three generic types of silicon diode failure under radiation are simulated. The simulation is applied to a full-wave, center-tap magnetic amplifier and a half-bridge, half-wave magnetic amplifier. Conclusions are drawn as to the most suitable basic diode type under radiation. Also discussed are: changes to be expected in magnetic amplifier performance as a result of radiation-induced diode effects; means of reducing some of these effects. (auth)

12205 NP-7365(Vol. 4)(Paper 46)

Lockheed Aircraft Corp. Missile Systems Div., Palo Alto, Calif.

GAMMA RADIATION EFFECTS IN SILICON SOLAR CELLS. G. Enslow, F. Junga, and W. W. Happ. Paper 46 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 37p. (LMSD-5137).

Ten silicon solar cells were irradiated by a 100-curie Co^{60} gamma source to a dose of 10^7 r. *In situ* measurements of the open-circuit voltage and short-circuit current were obtained. Calculations to predict the performance of silicon solar cells under irradiation were made on the basis of known properties of silicon and on the basis of models of radiation damage in solids. Calculated and experimental results were compared. The electrical characteristics of the solar cells were measured as a function of temperature before and after irradiation. The performance of a silicon solar cell power supply in radiation fields is discussed. (auth)

12206 NP-7365(Vol. 4)(Paper 47)

Army Signal Research and Development Lab., Fort Monmouth, N. J.

THE EFFECTS OF NUCLEAR RADIATION ON POWER TRANSISTORS. Frederick Gordon, Jr. Paper 47 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 23p.

The results of experiments performed to determine the effects of radiation on power transistors of various types are presented. A brief analysis of device parameter changes and of the evaluation of the results is presented. There is a short discussion of the interrelation between minimizing of the effects of nuclear radiation on transistors and the specific application of the devices. The device types that were exposed were homogeneous-base germanium power transistors. The device parameters that were monitored were small-signal and large-signal grounded-emitter current gain, as well as the reverse collector current. The techniques of measurement included multiple point measurements and curve tracer techniques. The results show fair agreement between experimental results and calculated values. (auth)

12207 NP-7365(Vol. 4)(Paper 48)

Cook Electric Co. Cook Research Labs. Div., Morton Grove, Ill.

THE PERFORMANCE OF SOME ZENER REFERENCE ELEMENTS DURING EXPOSURE TO NUCLEAR RADIATION. M. A. Xavier. Paper 48 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 22p.

Sixteen type 1N429 and sixteen type 1N430B Zener reference elements were exposed to the radiation field of a nuclear reactor. The measurement techniques and the corrections made to insure accurate results required in dealing with the voltage reference elements are described. Irradiations were performed at epicadmium neutron flux levels of the order of 10^{11} nvt until doses of up to 10^{16} nvt were reached. The corresponding gamma dose rate was 2.1×10^6 roentgens per hour. Detailed results are presented, and possible mechanisms of damage are described. The reference voltages of all the devices tested showed permanent decreases of up to 2.9 per cent although the average of the changes were in the order of $1\frac{1}{4}$ per cent. The temporary damage was generally about $\frac{1}{2}$ per cent. The case temperature was monitored for one sample in each of the four irradiations. (auth)

12208 NP-7365(Vol. 4)(Paper 49)

Wright Air Development Center, Aeronautical Research Lab., Wright-Patterson AFB, Ohio.

EFFECTS OF ELECTRON BOMBARDMENT ON CADMIUM SULFIDE WHISKERS. B. A. Kulp and D. C. Reynolds. Paper 49 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 4. ELECTRONICS AND SEMI-CONDUCTORS PAPERS. 8p.

Edge emission normally found in large crystals of CdS is not found in CdS whiskers and platelets in the as-grown condition. Bombardment of these whiskers by 700 and 500 kev electrons has brought out this emission. The threshold for producing the effect is being determined. (auth)

12209 NP-7365(Vol. 5)

Lockheed Nuclear Products, Marietta, Ga.

THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 266p. (NR-51(Vol. 5)).

Fourteen papers from the fifth session on the radiation effects on lubricants and plastics are presented. (W.D.M.)

12210 NP-7365(Vol. 5)(Paper 50)

Inland Testing Labs., Morton Grove, Ill.

THE BEHAVIOR OF FUELS AND LUBRICANTS IN DYNAMIC TEST EQUIPMENT OPERATING IN THE PRESENCE OF GAMMA RADIATION. M. Z. Fainman. Paper 50 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 12p.

Seventy-nine fuels and forty-one lubricants were studied to determine their suitability for use in a nuclear-powered aircraft. The materials were evaluated in dynamic test equipment operating in a gamma-radiation environment provided by 50,000 curies of Cobalt 60. The mechanical test machines used were those that have been useful in predicting the performance of fuels and lubricants in the aircraft gas turbine. These mechanical tests conducted at elevated temperatures in a radiation environment often affect materials more drastically and at lower doses of radiation than anticipated, indicating that it is necessary to assess the effects of mechanical, thermal, and radiation stresses as a combined environment. Ten fuels and six lubricants were chosen which showed the best performance. Sufficient data were accumulated to show that a number of these products will operate satisfactorily at radiation doses of at least 10^{10} ergs/gram carbon. These materials are suggested as the most satisfactory of those evaluated for use in a nuclear-propelled aircraft. (auth)

12211 NP-7365(Vol. 5)(Paper 51)

Wright Air Development Center, Materials Lab., Wright-Patterson AFB, Ohio.

THE DEVELOPMENT OF NUCLEAR RADIATION RESISTANT SOLID FILM LUBRICANTS. William L. R. Rice and William L. Cox. Paper 51 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 43p.

The effect of radiation on solid film lubricants is discussed. Data on wear life, corrosion resistance, fluid resistance, and thermal stability are reported for twelve films. Exposures were conducted in the presence of both gamma and neutron irradiations. In general,

little change was noted in the film performance indicating stability of the films. (auth)

12212 NP-7365(Vol. 5)(Paper 52)

Convair, Fort Worth, Tex.

THE INTEREFFECTS OF REACTOR RADIATION AND OIL. F. A. Haley. Paper 52 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 12p. (FZM-1155).

In an experiment to investigate the intereffects of oil and reactor radiation, six specimens of MIL-L-7808C aircraft turbine oil were irradiated in the form of slabs of one-half inch thickness. The specimens were stacked so that each acted to shield those behind it and the neutron and gamma radiation was measured between specimens. Comparison of measured values with theoretical curves for the change in the radiation field as it progressed through the oil shows that the attenuation of neutrons and gammas through oil can be predicted with reasonable accuracy. Although the doses received by the specimens were not sufficient to cause extensive degradation of properties, some increases in viscosity and neutralization number were noted, the extent of change in the oil nearer the reactor being greater than in the more remote specimens. (auth)

12213 NP-7365(Vol. 5)(Paper 53)

Shell Development Co., Emeryville, Calif.

DEVELOPMENT OF RADIATION-RESISTANT HIGH-TEMPERATURE LUBRICANTS. C. L. Mahoney, W. S. Saari, K. J. Sax, W. W. Kerlin, E. R. Barnum, and P. H. Williams. Paper 53 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 13p.

Polyphenyl ethers are very promising materials for further development as radiation-resistant high-temperature lubricants. The unsubstituted polyphenyl ethers are far more stable than presently-used lubricants and can be classed with the most resistant types of aromatic compounds with respect to radiation, oxidation, and thermal stability. Furthermore, these ethers have much lower melting points, better physical properties, and much better lubrication characteristics than the other aromatic materials. Liquid unsubstituted ethers having pour points of 5°F and 40°F have been prepared. Initial thermal decomposition temperatures of these ethers are 830°F or higher. Selected alkyl-substituted polyphenyl ethers, *o*-cumyl and *tert*-butyl derivatives, although less stable than the unsubstituted compounds are much more resistant to radiation, oxidation, and thermal decomposition than typical antioxidant-containing oils. (auth)

12214 NP-7365(Vol. 5)(Paper 54)

General Atomic Div., General Dynamics Corp., San Diego, Calif.

ELECTRICAL EFFECTS OF HIGH-INTENSITY IONIZING RADIATION ON NONMETALS. V. A. J. Van Lint and P. H. Miller, Jr. Paper 54 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 10p.

It is well-known that nuclear radiation produces permanent damage to electronic components. This damage is associated with the displacement of atoms from their normal sites in crystals and molecules. The advent of very intense sources of ionizing radiation has introduced

another problem into electronic circuitry—the transient electrical conductivity induced in otherwise poorly conducting materials. This conductivity is due to the electron excitation produced by the ionizing radiation. Experiments were performed to measure the magnitude of these effects. The radiation source used was an electron linear accelerator capable of delivering dose rates in excess of 10^8 rad/sec during 10- μ sec pulses. The materials studied include resistors, capacitors, and semiconducting diodes. (auth)

12215 NP-7365 (Vol. 5) (Paper 55).

Battelle Memorial Inst., Columbus, Ohio and Lockheed Aircraft Corp., Marietta, Ga.

RADIATION EFFECTS ON ELECTRICAL INSULATION. J. F. Hansen and M. L. Shatzen. Paper 55 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS. 11p.

Eight types of insulated, electrical wire were irradiated to a dose of about 1×10^{10} ergs/g(C) at temperatures of 15, 55, and 100°C, and relative humidities of 0 and 65% at each temperature in a cobalt-60 gamma source. Electrical resistance was measured before, during, and after irradiation; preirradiation and postirradiation breakdown voltage measurements were made, and the specimens were examined visually for signs of physical deterioration after irradiation. All insulations exhibited a loss in initial resistance of at least 99% at one or more of the irradiation conditions. Serious deterioration of mechanical properties was observed for all except two polyethylene insulations. In general, best performance, from the standpoint of electrical properties, was obtained under cool, dry conditions. On the average, high temperature had a greater detrimental effect than high humidity. The temperature effect was most pronounced between 15 and 55°C. For general-purpose use in a radiation field, under a variety of temperature and humidity conditions, polyethylene appears to be superior to the other materials studied. However, under specific controlled temperatures and humidities some of the other materials may be preferred. (auth)

12216 NP-7365 (Vol. 5) (Paper 56)

Lockheed Nuclear Products, Marietta, Ga. and Battelle Memorial Inst., Columbus, Ohio.

A STUDY OF RADIATION EFFECTS ON FUEL TANK SEALANTS AND BLADDER CELL MATERIAL. M. L. Shatzen, Jr., R. S. Tope, C. W. Cooper, and R. G. Heiligmann. Paper 56 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 13p.

The effects of exposure to gamma irradiation were studied on two commercial thiokol based sealants and one high-temperature bladder cell material. Samples were tested dry in their original cured state then, after exposure to 140°F, immersed in JP-4 fuel for periods equivalent to those required to reach the three radiation doses used. After gamma irradiation at 140°F, they were immersed in JP-4 fuel to radiation doses of 9.3×10^8 , 3.5×10^9 , and 9.9×10^9 ergs/gm (carbon). The sealants showed about 10% degradation at the intermediate dose level and serious damage at the highest dose level. The bladder cell material apparently withstood a dose of 9.9×10^9 ergs/gm (carbon) at 140°F in JP-4 without great damage. (auth)

12217 NP-7365 (Vol. 5) (Paper 57)

General Atomic Div., General Dynamics Corp., San Diego, Calif.

THE EFFECT OF ELECTRON RADIATION ON THE COMPLEX DYNAMIC MODULUS OF POLYSTYRENE AND HIGH-DENSITY POLYETHYLENE. R. H. Chambers. Paper 57 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 11p.

Measurements of the elastic modulus and mechanical loss at 5 to 10 kcps were made on nonirradiated and 5-Mev-electron-irradiated specimens of polystyrene and high-density polyethylene over a temperature range from 80° to 320°K. Specimens were irradiated at liquid-nitrogen and room temperatures to doses of up to 7×10^7 rads. Considerable dependence of the modulus on irradiation temperature was noted in polyethylene. The polystyrene specimens exhibited marked modification of the internal friction spectrum under room-temperature irradiation. These changes in the dynamic modulus are discussed in terms of early-stage cross-linking mechanisms. (auth)

12218 NP-7365 (Vol. 5) (Paper 58)

Dow Corning Corp., Midland, Mich.

RADIATION RESISTANT SILICONES. E. L. Warrick, D. J. Fischer, and J. F. Zack, Jr. Paper 58 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 22p.

Silicones as a class cover a wide range of polymer compositions within which are newer materials of outstanding radiation resistance. These take the form of fluids, greases, resins, and rubbers. Inherently, silicones are thermally stable and this is reflected in excellent performance for some polymers in the combined environments of radiation and high temperature. Comments in the literature which classify silicones as poor in radiation resistance are based on observations covering only a limited area of the total field with concentration on a few of the less stable polymers. (auth)

12219 NP-7365 (Vol. 5) (Paper 59)

Convair, Fort Worth, Tex.

RADIATION EFFECTS ON ORGANO-SILICONS. T. W. Albrecht. Paper 59 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 10p. (FZM-1157).

The heat, radiation, and oxidative stability of silicon materials is discussed. A stepwise energy reduction mechanism for oxygen is proposed that allows molecular oxygen to be changed to atomic oxygen in 30-40 Kcal increments rather than in steps of 96 Kcal. The mechanism helps explain the relative ease of oxidation of silicon materials and the products formed at relatively low temperatures. (auth)

12220 NP-7365 (Vol. 5) (Paper 60)

National Bureau of Standards, Washington, D. C.

RADIATION CHEMISTRY OF FLUOROCARBON POLYMERS AND MONOMERS. L. A. Wall, R. E. Florin, and D. W. Brown. Paper 60 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 27p. (NBS-6126).

The changes in polymers irradiated with Co^{60} gamma rays were studied with reference to formation of gas molecules, crosslinking, and scission in air and in vacuum, as evidenced by mechanical properties such as "zero-strength-time" and free-radical accumulation and disappearance as shown by electron spin resonance.

The polymers studied were: Teflon, Teflon 100X, Kel F, elastomer, Viton A, and trifluoroethylene. These polymers show great differences in radiation stability depending upon environment and constitution. The molecule hexafluorobenzene showed outstanding radiation stability, approximately comparable to benzene, and would be a promising basis for the preparation of resistant polymers. Mixtures with added hydrocarbon materials were somewhat less stable. It appears that radicals in Teflon build up approximately linearly, at least up to a dose of 72 megr, and disappear very slowly in vacuum, while in a perfluoropropene-tetrafluoroethylene copolymer the radical concentration shows signs of leveling off at 50 megr and probably declines somewhat in two days. (auth)

12221 NP-7365(Vol. 5)(Paper 62)

Boeing Airplane Co., Seattle.

EFFECTS OF NUCLEAR RADIATION ON CORK, LEATHER, AND ELASTOMERS. Chester J. DeZeh. Paper 62 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 24p. (D2-1819).

Samples of cork, leather, and various elastomers were irradiated in a cobalt-60 gamma source at dosages of $\sim 10^7$ to 10^{10} ergs/gram. No significant changes were observed for cork. Tensile strength of leather was affected; no hardening was noticed. Elastomers SE-551 and SE-371 are affected by nuclear radiation. At ca. 10^{10} ergs tensile strength and elongation properties decrease considerably, while hardness increases to the point of crumbling. High temperature Thiokol exhibits good properties after irradiation. Viton A retains usable tensile strength up to ca. 10^{10} ergs, with some increase in hardness. At ca. 10^{10} ergs the percent of elongation of Viton A drops considerably. (auth)

12222 NP-7365(Vol. 5)(Paper 63)

Convair, Fort Worth, Tex.

THE PLATE SHEAR METHOD FOR DETERMINING RADIATION EFFECTS ON THE MODULUS OF RIGIDITY OF HONEYCOMB SANDWICH PANELS. R. R. Bauerlein. Paper 63 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 6p. (FZM-1161).

A new testing method—the Plate Shear Method—was developed for obtaining the modulus of rigidity in a mixed radiation field. The Plate Shear Method has proved to be more consistent and more reliable than the Beam Deflection Method. Furthermore, it is adaptable to testing during the irradiation process. The Plate Shear Method, its application, and the remotely controlled equipment required for its application are described. The advantages of the new method in yielding design data on honeycomb sandwich panels being tested for use in a nuclear-powered aircraft are described. (auth)

12223 NP-7365(Vol. 5)(Paper 65)

Convair, Fort Worth, Tex.

RADIATION EFFECTS ON 23 SILICONE RUBBERS AT AMBIENT TEMPERATURE. D. M. Newell. Paper 65 [of] THIRD SEMI-ANNUAL RADIATION EFFECTS SYMPOSIUM [HELD IN ATLANTA], OCTOBER 28-30, 1958. VOLUME 5. LUBRICANTS AND PLASTICS PAPERS. 39p. (FZM-1156).

Convair-Fort Worth conducted screening tests on 23

silicone rubbers, irradiated at three temperatures and four fluxes. The Ground Test Reactor was used. The information obtained to date is from tests conducted during February and March 1957. Standard physical tests were performed. The materials were obtained from Dow Corning, General Electric, and Union Carbide. The materials found to be the most radiation resistant were: Silastic 7-170, SE 381, Silastics 2048, and 80, and 81641 (GE). There was a definite correlation between the filler content and the damage, with the percent damage varying inversely with the percent filler. (auth)

12224 NP-7380

Royal Dutch/Shell Group of Companies, Hague.

SHELL ATOMIC POWER LUBRICANTS. Interim Report. 1958. 27p.

An outline of development of radiation-resistant lubricants for use in nuclear power stations and other facilities in which radioactive materials are handled is presented. Effects of nuclear radiation on hydrocarbon oils, greases, and synthetic fluids are examined, as well as Shell wide-range lubricants, Shell APL Products, and special lubricants for Bradwell. Also included is a section on the general applications of lubricants in nuclear power plants. (J.R.D.)

12225 NP-7460

Alabama. Univ., Tuscaloosa.

THE STRUCTURE OF V CENTERS IN IRRADIATED $KClO_3$. Interim Technical Report No. 1. T. E. Hasty, W. B. Ard, Jr., and W. G. Moulton. Apr. 1, 1959. 31p. Contract DA-01-009-ORD-561.

On the basis of the electron spin resonance spectra of a single crystal of $KClO_3$ which was exposed to x irradiation, a model is proposed for the V center produced. The center proposed consists of a ClO radical covalently bonded to a neighboring ClO_3^- ion. It is shown that the electron spin resonance spectra predicted for this radical agrees with the observed spectra, both in the number and spacing of the hyperfine components and their orientation dependence in the external magnetic field. It is also proposed that an O_2^- center is produced rather than the usual F center which one might expect to accompany the V center. (auth)

12226 NYO-8532

Brown Univ., Providence.

RADIATION DAMAGE STUDIES USING THE TECHNIQUES OF ELECTRON-SPIN PARAMAGNETIC RESONANCE. Period covered: May 1, 1958 through April 30, 1959. P. J. Bray and A. O. Williams, Jr. Mar. 23, 1959. 17p. Contract AT(30-1)-2024. \$3.30 (ph), \$2.40(mf) OTS.

LiF crystals were subjected to neutron irradiations between 7×10^{13} and 3×10^{17} nvt. The F-type center, exhibiting 29 or more ESR hyperfine components whose separation and resolution depend on orientation of the applied magnetic field, was observed in all samples. The F-type center apparently does not arise from an impurity. Crystals subjected to x radiation yield the same spectrum. Crystals receiving small neutron dosages ($\sim 10^{14}$ nvt) exhibit additional lines which are also observed in gamma-irradiated specimens. V-type centers, stable at room temperature, were found in crystals which have received neutron dosages of more than 10^{15} nvt. Crystals which have received neutron dosages of 10^{18} to 10^{19} nvt exhibit an additional narrow, intense resonance apparently arising from conduction electrons in lithium metal formed by the irradiation. Progress is reported on studies of irradiated NaF, LiI, NaCl, KCl,

KBr, KI, RbI, boron-containing glasses, azides, corundum, spinel, and rutile. (auth)

12227 QMFCI-5-58

Quartermaster Food and Container Inst. for the Armed Forces, Chicago.

PROCEEDINGS [OF THE] CONTRACTORS' FIFTH ANNUAL MEETING QUARTERMASTER CORPS RADIATION PRESERVATION OF FOODS PROJECT HELD AT MOUNTAIN VIEW HOTEL, GATLINBURG, TENNESSEE, JANUARY 27-31, 1958. Mar. 1958. 86p.

A summary of the proceedings is presented covering the following topics: radiation effects on food, packaging problems, radiation sources and dosimetry, wholesomeness and nutritional adequacy of irradiated foods, food irradiation studies in other countries, planning the USAIRC, industry views, participation of the Surgeon General, and Interdepartmental Committee outlook. (T.R.H.)

12228 QMFCI-34-57

Quartermaster Food and Container Inst. for the Armed Forces, Chicago.

HISTORY AND STATUS OF THE QUARTERMASTER CORPS; RADIATION PRESERVATION OF FOODS PROJECT (7-84-01-002). 1956. 202p.

The history is given of the 5-year investigative Quartermaster Corps' Radiation Preservation of Foods Project begun in 1953. Technical progress to about August 1956 is related. The currently available types and sources of radiations found best suited for various food processing purposes to date are discussed, and the microbiological, chemical, nutritional, and wholesomeness studies effected on irradiated food are reviewed. More than 100 foods have been screened for effects of irradiation and many of these foods are being studied intensively. Sensory acceptance and storage stability of foods preserved by irradiation are discussed in detail. In many cases it has been necessary to develop new methodology to permit study of the minute chemical changes which occur in foods during irradiation, and developments in this methodology are reported. It has been ascertained that irradiation will be practical and feasible for inhibiting sprout growth in tubers, controlling trichina in pork, treating grains and cereal products for insect destruction, and prolonging shelf-life of certain foods at either pasteurization or sterilization dose levels with or without refrigeration. Since no commercial food processing plant for irradiation of food has yet been built economic data are limited. Preliminary estimates are included, however. (auth)

12229 REIC-1(Add.)

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECTS OF NUCLEAR RADIATION ON SEMICONDUCTOR MATERIALS (FIRST ADDENDUM). L. W. Aukerman. Mar. 31, 1959. 33p. Project No. 2133. Contract AF33(616)-5171. (AD-210758).

The literature on the effects of high energy radiation on semiconductor materials received by the Radiation Effects Information Center during 1958 and 1959 was reviewed and compared. The materials covered are germanium, silicon, and several compound semiconductors including indium antimonide, gallium antimonide, indium arsenide, aluminum antimonide, and gallium arsenide. All types of irradiation capable of producing permanent damage are considered. A rather serious discrepancy between theory and experiment appears to be present in most cases investigated. (auth)

12230 REIC-4(Add.)

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECT OF NUCLEAR RADIATION ON LUBRICANTS AND HYDRAULIC FLUIDS (FIRST ADDENDUM). S. L. Cosgrove. Mar. 31, 1959. 49p. Project No. 2133. Contract AF33(616)-5171. (AD-210760).

Radiation-resistant gas-turbine-lubricant development during 1958 was centered around the expanded study of polyphenyl ethers and alkylated aromatic ethers. Meta-linked polyphenyl ethers (uninhibited) show promise for use in the 0 to 700°F range and at exposures up to 1×10^{11} ergs g⁻¹(C). Alkylated aromatic ethers (containing antioxidants) are somewhat less radiation stable, but show a useful temperature range of approximately -35 to 600°F. Alkylated diphenyl ethers and diaryl alkanes show the most promise for use in conventional hydraulic systems under irradiation conditions. In hydraulic systems which would tolerate high pour points (about 5°F) and marginal high-temperature viscosity, unsubstituted polyphenyl ethers could be used to advantage. The combination of radiation-stable fluids and modified soap (terephthalamates) or nonsoap thickeners has resulted in greases of adequate radiation stability for anticipated ANP needs. Likewise, commercially available dry-film lubricants show adequate radiation stability for anticipated ANP applications. (auth)

12231 REIC-Memo-13

Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio.

THE EFFECT OF NUCLEAR RADIATION ON ORGANIC HEAT-TRANSFER MATERIALS. Robert E. Wyant. Feb. 28, 1959. 18p. Project No. 2133. Contract AF33(616)-5171.

A summary of the information available at the Radiation Effects Information Center on the radiation stability of organic heat-transfer materials is presented. Of the materials surveyed, the terphenyls show the greatest radiation resistance and are the preferred class of organic heat-transfer materials for high radiation exposures. At low exposures, the para isomer shows the greatest resistance, while at higher exposures the three isomers approach one another in stability. Monoisopropylbiphenyl, biphenyl, diphenyl ether, and silicate esters also appear to possess good radiation stability. Ethylene glycol, chlorinated diphenyls, DC-710 silicone, and phosphate esters have poor stability and should probably not be used where total exposure exceeds about 8.5×10^9 ergs g⁻¹(C). (auth)

12232

THE SURFACE HARDENING OF X-IRRADIATED NaCl. E. Aerts, S. Amelinckx, and W. Dekeyser (Laboratorium voor Kristallkunde, Ghent). *Acta Met.* 7, 29-42 (1959) Jan.

The increase in Vickers hardness due to exposure of NaCl single crystals to 40 kv unfiltered x rays is studied both as a function of irradiation time and of depth, i.e., the distance from the surface facing the beam. The optical absorption was also measured, as a function of these variables, on the same crystals in order to find a possible correlation between hardness increase and color center concentration. The effect of optical and thermal bleaching was also followed. It is found that the hardness near to the surface is influenced by the presence of a free surface; when thin specimens are used an increase in hardness is found on both surfaces. All observations can satisfactorily be explained

If the surface hardening is assumed to be due to the formation of small colloids. The hardening is then quite similar to precipitation hardening in an alloy. The formation of the colloids is analogous to the "printing-out" process in silver bromide exposed to light. (auth)

12233

THE ACTION OF REACTOR RADIATION ON SATURATED FLUOROCARBONS. J. H. Simons and Ellison H. Taylor (Univ. of Florida, Gainesville and Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **63**, 636-7(1959) Apr.

The stability of fluorocarbons to heat and to most reagents led to hopes of a similar high stability to ionizing radiation. The fluorocarbons C_7F_{16} , $C_8F_{18}O$, and $(C_4F_9)_3N$ were purified by evacuation while frozen, melting, refreezing, and further evacuation, followed by distillation through P_2O_5 into the irradiation vessel. The samples were irradiated for 4 weeks in the Oak Ridge Graphite Reactor at a neutron flux of $5.5 \times 10^{11} \text{ cm}^{-2} \text{ sec}^{-1}$ and at a maximum temperature of 110° . Results of the examination of the irradiated samples are given. The irradiation effected chemical changes in these three samples. (W.L.H.)

12234

CONDUCTIVITY INDUCED BY RADIATION IN POLYCRYSTALLINE CADMIUM SULPHIDE AND POLYETHYLENE. C. G. Clayton and B. C. Haywood (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and J. F. Fowler (King's Coll. Hospital, London). *Nature* **183**, 1112-13(1959) Apr. 18.

Ionizing radiation on insulators or semiconductors produces electron-hole pairs; when irradiation is stopped, electrons are released from traps into the conduction band. The curve of conductivity decay resulting is hyperbolic. Results of studies with CdS and polyethylene are cited to support the idea of photoconductive trapping and decay. (T.R.H.)

12235

THE QUESTION OF SPIKE FORMATION IN RADIATION DAMAGE WITH CHARGED PARTICLES. Ulrich Gonser (Gesellschaft zur Förderung der Kernphysikalischen Forschung, Aachen). *Nukleonik* **1**, 182-3(1959) Apr. (In German)

The question of spike formation was discussed for charged and uncharged primary particles. For charged particles the end of the orbit was distinguished by the formation of spikes. The formation mechanism was described qualitatively. (tr-auth)

12236

COLORATION OF BIOTITES BY α -PARTICLES IN PLEOCHROIC HALOES. II. S. Deutsch (Université Libre, Brussels) and P. Janssens (Institut Technique Supérieur de l'Etat pour les Industries Nucleaires, Brussels). *Nuovo cimento* (10) **11**, 473-83(1959) Feb. 16.

The coloration of biotites by α particles was investigated as a function of the number of displaced atoms. The number was calculated by means of the theory of F. Seitz. The coloration increases, saturates, and diminishes with increasing number of ions. (auth)

12237

ENERGY LEVELS IN IRRADIATED GERMANIUM. E. L. Blount (Westinghouse Research Labs., Pittsburgh). *Phys. Rev.* **113**, 995-8(1959) Feb. 15.

The energy levels found in germanium irradiated by

different particles seem at first to be mutually inconsistent. It is possible tentatively to reconcile the differences by consideration of clustering and association of defects. Four levels are ascribed to single vacancies and interstitials. A crude theory is constructed to explain these levels, particularly their asymmetrical distribution in the energy gap, and to assign each to a definite defect. This theory differs somewhat from a previous one due to James and Lark-Horovitz; some differences in experimental predictions are discussed in particular. (auth)

RADIOACTIVE WASTE**12238 ARSC-28(Del.)**

Air Reduction Sales Co. Research Labs., Murray Hill, N. J.

THE REMOVAL OF IODINE FROM GAS STREAMS BY REACTION WITH SILVER IN PACKED TOWERS. R. McNabney and A. M. Lyon. Aug. 26, 1949. Decl. with deletions Mar. 24, 1959. 31p. Contract AT-30-3-GEN-2. \$9.30(ph), \$3.60(mf) OTS.

A process was developed for the removal of iodine alone in the presence of the various other constituents of pile dissolver off-gases. The principal feature of the process is the use of a column packed with Berl saddles coated with silver nitrate or silver. Experiments were conducted using a column with a packed section 17 in. long by 2 in. diameter through which was passed a stream of air at 2 cfm containing NO_2 , water vapor, and iodine. This tower operating on this gas stream is equivalent to a 6-foot plant scale tower operating on Hanford off-gases. (auth)

12239 BNL-535

Brookhaven National Lab., Upton, N. Y. CALCINATION OF HIGH LEVEL ATOMIC WASTES AS A STEP IN ULTIMATE DISPOSAL. R. F. Domish, E. J. Tuthill, and L. P. Hatch. Dec. 1958. 14p. \$0.50 (OTS).

Safe and permanent disposal of high-level wastes includes two basic objectives: immobilization of the fission products by incorporation in stable solids, and reduction of the stored product to the minimum practical volume. Calcination is a desirable first step in the processing of radioactive waste solutions containing relatively large amounts of aluminum nitrate and zirconium fluoride because thermal decomposition and steam hydrolysis convert these substances to insoluble solid oxides which, after a preliminary leaching to remove the unfixed portion of the activity are suitable for burial. Over the past four years a calcining apparatus of the rotary ball kiln type with dust controlled by condensation and absorption of the off-gases has been developed at Brookhaven National Laboratory. Calcination in rotary ball kilns appears to be entirely practical with respect to product quality, mechanical design, corrosion, off-gas volume, and dust control. (auth)

12240 BNL-3283

Brookhaven National Lab., Upton, N. Y. WATER SUPPLY AND DRAINAGE QUANTITIES FOR RADIOACTIVITY LABORATORIES. John M. Ruddy. July 9, 1957. 7p. \$1.80(ph), \$1.80(mf) OTS.

The laboratory liquid waste effluent at Brookhaven National Laboratory is discussed in relation to the number of personnel and flow-rate per fixture per day of contaminated and uncontaminated waste. (W.L.H.)

12241 CF-59-3-56

Oak Ridge National Lab., Tenn.

CALCULATIONAL MODELS OF POT CALCINATION. M. E. Whitley and J. J. Perona. Mar. 23, 1959. 10p. Contract [W-7405-eng-26]. \$1.80(ph), \$1.80(mf) OTS.

A simplified model for solids deposition in the pot calcination of waste was analyzed, and numerical calculations were made. In long calcination pots of 10 to 12 in. diameter, calcination times should not exceed 24 hours and might be as low as three hours if the pot is kept full. If the pots are fed at a constant rate, the cake might form with a steady state "V" when viewed in vertical section which would progress from bottom to top. Cake deposition rates appear to be independent of pot radius. Several advantages to using larger diameter pots are discussed. (auth)

12242 HW-49723

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE EFFECT OF GROUND-WATER MOUNDS ON THE PUREX OPERATION. William H. Bierschenk. Apr. 18, 1957. 18p. Contract [W-31-109-Eng-52]. \$3.30(ph), \$2.40(mf) OTS.

A review of the changes in the size and shape of the ground-water mounds consequent upon disposal of cooling water from both the former B Plant operation and the present Purex operation is reported. The results of pertinent ground-water and waste monitoring studies and recommendations and a forecast of future hydrologic conditions attendant upon disposal of Purex cooling water are summarized. Channels of rapidly moving ground water were identified flowing eastward along the northern and southern flanks of Gable Mountain and flowing southeastward from Chemical Separations Areas toward 300 Area. Contaminated ground water from beneath 200-East disposal cribs routed to these channels would be rapidly transported to the Columbia River. This undesirable movement of contamination could be largely controlled hydrologically by the formation of three ground-water mounds. Proper distribution of Purex cooling water to three swamps, located respectively north, east, and southeast of 200-East Area, could be expected to raise underlying water levels to such an extent that hydraulic gradients would be locally reversed, preventing contaminated ground water from reaching the highly permeable channels. (auth)

12243 HW-51399

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CALCULATION OF PUREX A-8 CRIB CAPACITY. H. L. Brandt. July 9, 1957. 10p. Contract [W-31-109-Eng-52]. \$1.80(ph), \$1.80(mf) OTS.

Strontium-90 was found to be the critical isotope for disposal purposes in the A-8 crib waste. A linear relationship was found between the probability distribution of C/C_0 for Sr^{90} and the logarithm of the volume of A-8 waste run through 80 cm laboratory soil columns. Owing to the inaccuracy of Sr^{90} analyses in concentrations less than $4.5 \times 10^{-6} \mu\text{c/cc}$, an extrapolation of the breakthrough curve was required to the limiting concentration of $8 \times 10^{-6} \mu\text{c/cc}$ to determine column capacity. If it may be assumed that the observed linear relationship is independent of the length of the soil column, a method becomes available for calculating the usable capacity of the 200-foot column of soil underlying the A-8 crib. Calculations by this means show that 285 million gallons of A-8 waste may be discharged to this crib before the

Sr^{90} would exceed $8 \times 10^{-6} \mu\text{c/cc}$ in the ground water. (auth)

12244 HW-52401

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DILUTION OF 300 AREA URANIUM WASTES ENTERING THE COLUMBIA RIVER. W. A. Haney. Sept. 9, 1957. 15p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

Uranium wastes from 300 Area Facilities entering the Columbia River during normal river stage are diluted to less than 1/500th of the concentration in the Pond by the time the wastes reach the Hanford Works river boundary. This dilution results in a uranium concentration in the river at essentially background when the concentration in the Pond is maintained at or near its present level of $6 \times 10^{-7} \mu\text{c U/cc}$. (auth)

12245 HW-55249

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECTS OF DIRECT DISPOSAL OF REACTOR EFFLUENT WATER TO THE RIVER. R. B. Hall, W. N. Koop, and J. D. McCormack. Mar. 6, 1958. 5p. Contract [W-31-109-Eng-52]. \$1.80(ph), \$1.80(mf) OTS.

The present condition of the reactor retention basins has lead to studies to determine possible modifications to improve the integrity of the effluent systems. The most attractive solution involves discontinuing the retention of effluent water. A review of knowledge gained from experience and study concerning the radiological effects which will result from the disposal of effluent water directly to the river is presented. (W.L.H.)

12246 ORNL-2700

Oak Ridge National Lab., Tenn.

STATUS REPORT ON WASTE DISPOSAL IN NATURAL SALT FORMATIONS: II. F. L. Parker, W. J. Boegly, Jr., R. L. Bradshaw, J. Crowell, E. R. Eastwood, F. M. Empson, B. D. Gunter, L. Hemphill, O. H. Myers, and E. G. Struwness. Apr. 23, 1959. 56p. Contract W-7405-eng-26. \$9.30(ph), \$3.60(mf) OTS.

Radioactive liquid wastes can be stored in cavities in natural salt formations if the structural properties of salt are not adversely affected by chemical interaction, pressure, temperature, and radiation. Analytical studies show that it is possible to store two-year-old waste in a 10-foot-diameter sphere without exceeding a temperature of 200°F. Laboratory tests show that the structural properties of rock salt are not greatly altered by high radiation doses, although high temperatures increase the creep rate for both irradiated and unirradiated samples. Chemical interaction of liquid wastes with salt produces chlorine and other chlorine compound gases, but the volumes are not excessive. The migration of nuclides through the salt and deformation of the cavity can only be studied in the field in undisturbed salt in place. The design of a field experiment is complete, and the materials for construction of the cavity cover and off-gas system have been chosen. (auth)

12247 USNRDL-460

Naval Radiological Defense Lab., San Francisco.

THEORY OF DECONTAMINATION. PART I. C. F. Miller. July 15, 1958. 120p.

The basic chemistry and physics of decontamination are discussed in an attempt to organize the concepts and available data. The current concepts of contamination by and decontamination of radioactive fall-out, a review

of experimental methods that have been or could be utilized in the investigation of decontamination, illustration of the technical principles involved by evaluating theoretical parameters from available data, and a presentation of a number of new theoretical equations describing the chemical behavior of contaminated systems are summarized. (J.E.D.)

REACTORS

General

12248 AAEC/E-1

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. RELATIVE HOLDUP OF HEAT EXCHANGERS FOR CIRCULATING FUEL SYSTEMS. C. L. W. Berglin. June 1958. 20p.

The relative holdup for tube-type heat exchangers of Na-U suspension and Bi-U solution systems for various sizes of tube and tube wall thickness is examined. Based on a temperature difference of 50°C, the holdup in the heat exchanger for the Na-U suspension is 6 times that for the Bi-U solution. A table is included of the leading dimensions of heat exchangers for a heat load of 500 Mw with tubes of $\frac{3}{4}$ and 1 in. outside diameter, respectively. (auth)

12249 AAEC/E-2

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. SUGGESTIONS FOR WORK ON DESIGN OF HEAT EXCHANGERS IN LIQUID METAL FUELLED REACTORS. C. L. W. Berglin. June 1956. 8p.

A discussion is presented of the heat transfer film coefficient for the secondary coolant side of tubular exchangers. The coefficient was used in calculations included in AAEC/E-1. The types of heat exchangers which should be investigated to improve this coefficient are suggested. (J.R.D.)

12250 AAEC/E-3

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. BEHAVIOR OF PARTICLES OF U, UO_2 AND UC_2 IN A VERTICAL TUBE THROUGH WHICH LIQUID SODIUM IS FLOWING. C. L. W. Berglin. June 1956. 17p.

The relation between the particle velocity and the fluid velocity in a vertical tube without making any assumptions as to the apparent viscosity of the suspension of particles in liquid sodium is examined. The theory and calculations method is developed for suspensions of U, UO_2 , and UC_2 in liquid Na in the temperature range 200 to 800°C. (auth)

12251 AAEC/E-4

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. PRELIMINARY DESIGN OF ANNULAR TUBE HEAT EXCHANGERS FOR CIRCULATING FUEL SYSTEMS. C. L. W. Berglin. Feb. 1957. 9p.

A suggestion appearing in AAEC/E-2 is developed, and it is shown that the annular tube heat exchanger for circulating fuel systems is practical. (J.R.D.)

12252 AAEC/E-10

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales. SOME MAJOR DESIGN PARAMETERS FOR THE

H.T.G.C. REACTOR PROJECT. W. H. Roberts. Oct. 1958. 30p.

Estimates of various HTGCR Parameters are presented. The design study is not exhaustive; however, reasonable starting points are included. (J.R.D.)

12253 AMF-GR-5-57

AMF-GR-27-57

American Machine and Foundry Co. Nuclear Engineering Lab., Greenwich, Conn.

FEASIBILITY INVESTIGATION OF A CLOSED CYCLE BOILING WATER REACTOR FOR THE PROPULSION OF A MERCHANT SHIP. Apr. 8, 1957. 380p. Addendum I. Sept. 30, 1957. 227p. Contract MA-1263. (AMF-GR-5-57, \$5.00(OTS) and AMF-GR-27-57, \$3.50(OTS).)

This report and addendum were issued separately, but are cataloged as a unit.

AMF-GR-29-56; AMF-GR-22-57; AMF-GR-28-57; AMF-GR-26-57; and AMF-GR-25-57 are contained in the addendum (AMF-GR-27-57).

The feasibility of a nuclear-powered tanker was studied. The AMF Closed Cycle Boiling Water Reactor System is recommended for this application. The reactor and all associated systems to supply the thermal demands are described. Also, descriptions are given of the core, vessel, shielding, and primary piping systems as well as auxiliary systems that are closely related to the reactor primary. A containment vessel houses the entire primary system and provides mechanical support for part of the secondary shield. An addendum consisting of four reports is included in which a summary is given of shielding, physics, and fuel analysis work carried out as part of phase I. Also, the economics of a reference design were determined as well as parameters affecting these results. (J.R.D.)

12254 ANL-5923

Argonne National Lab., Lemont, Ill. and Argonne National Lab., Idaho Falls, Idaho.

HAZARDS SUMMARY REPORT ON THE TRANSIENT REACTOR TEST FACILITY (TREAT). D. R. MacFarlane, G. A. Freund, and J. F. Boland. Oct. 1958. 64p. Contract W-31-109-eng-38. \$1.75(OTS).

TREAT is a versatile transient irradiation test facility designed primarily to melt segments of proposed cores of fast reactors under conditions analogous to a power excursion in a fast reactor. The unique design of TREAT provides for the visual observation and recording by motion picture of events during the melting. Thus TREAT represents a two-fold contribution to the advancement of fast reactor safety technology and design: (1) it will provide basic data for predicting the severity of potential incidents; and (2) it will serve as a proving ground for fuel concepts designed to minimize or preclude the hazards resulting from their occurrence. The initial tests will be confined to single, EBR-II-type fuel pins in an inert gas atmosphere. Eventually the test program may be extended to a 19-pin cluster, or perhaps to a full-scale, 91-pin EBR-II subassembly in flowing sodium. Detailed site, facility, and hazards evaluations are included. (auth)

12255 ANL-LAT-86

Argonne National Lab., Lemont, Ill.

MEASUREMENT OF NEUTRON FLUX IN THE EBR. P. J. Persiani and G. R. Ringo. May 16, 1952. 6p. \$3.30(ph), \$2.40(mf) OTS.

A study of the neutron flux distribution in the EBR was made utilizing the neutron activation of Au and P foils. The 270-min activity on the P foils coming from an (n,p)

reaction with a 1-Mev threshold was taken as a measure of the fast neutrons and the Au activity as a measure of the slower ones. The foils were standardized by activation on a U^{235} converter plate. The positions in the reactor measured are shown, and the results are tabulated. The neutron leakage was calculated to be 3.5% of production from measurements of the thermal neutron current in the thermal column. (auth)

12256 CF-5035

Gt. Brit. Dept. of Atomic Energy. Industrial Group
H. Q., Risley, Lancs, England.
TESTS ON A CENTRE ENTRY MODEL. J. L. Dickson.
[Aug. 1950]. 16p. (FPP-10).

Tests have been carried out on a model of a suggested method of introducing a gas coolant into a center entry pile. The results indicate that with the designs of entry tested, losses occur in channels which are of the order 0.8 to 1.0 times the velocity head in the string when the header velocity is less than or equal to the string velocity. When the header velocity is greater than the string velocity, the loss is much higher and the velocity distribution between the strings is uneven. While these losses are probably acceptable as a basis for development, the lack of uniform distribution of coolant between the strings seems a more serious difficulty. (W.D.M.)

12257 DP-330

Du Pont de Nemours (E. I.) & Co. Savannah River
Lab., Augusta, Ga.
CONTROL ROD CALIBRATIONS IN THE STANDARD
PILE. Harold R. Fike. Jan. 1959. 16p. Contract
AT(07-2)-1. \$0.50(OTS).

The Standard Pile of the Savannah River Laboratory, which is similar to the Thermal Test Reactor developed by the Knolls Atomic Power Laboratory, has three control rods which were calibrated by period measurements. (auth)

12258 HW-59014(Rev.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
FLOW DECAY AFTER AN ELECTRICAL POWER OUTAGE IN THE PRTR. J. Muraoka. Feb. 6, 1959. 5p.
Contract [W-31-109-Eng-52]. \$1.80(ph), \$1.80(mf) OTS.

The effects of electrical power loss to the PRTR primary coolant pump were studied. It was concluded that the flow provided by the stored kinetic energy and natural convection is adequate to suppress bulk boiling in the primary coolant from heat produced by the hot channel. It is recommended that the pumps be removed from the line after 2 minutes; however, natural convection suppresses boiling after 45 seconds following electrical outage. (J.R.D.)

12259 JAERI-1003-B

Japan. Atomic Energy Research Inst., Tokyo.
PRE-CRITICAL TESTS FOR JRR-1. Apr. 1958. 24p.
Tests on various equipment and instruments inside the primary enclosure of JRR-1 prior to criticality are described. The components in the primary system include the core, the gas recombiner, the fuel drain tank, 12 valves, and tubing. Checks of installation, welding, measurements, etc. started on May 11, 1957 and the reactor reached criticality on Aug. 27, 1957. (W.D.M.)

12260 JAERI-1003-C

Japan. Atomic Energy Research Inst., Tokyo.
PREPARATION OF THE FUEL SOLUTION FOR THE
JRR-1. 1958. 15p.
The fuel solution for JRR-1 was prepared by dissolv-

ing the uranyl sulfate in sulfuric acid with the addition of Fe^{2+} , Cu^{2+} , and Al^{3+} ions in the form of $FeSO_4 \cdot 7H_2O$, $CuSO_4 \cdot 5H_2O$, and $Al_2(SO_4)_3 \cdot 18H_2O$. Fe^{2+} and Cu^{2+} served as catalysts for the decomposition of H_2O_2 formed by the radiolysis of water, and the Al^{3+} served to form a stable aluminum fluorine complex ion. The solution was prepared in two batches of 12 and 4.5 l. (W.D.M.)

12261 JAERI-1003-D

Japan. Atomic Energy Research Inst., Tokyo.
CRITICAL EXPERIMENT FOR JRR-1. Apr. 1958. 26p.
Criticality experiments for the 50-kw homogeneous uranyl sulfate solution research reactor JRR-1 are described. Critical mass was found to be about 1170 grams of U^{235} . Neutron multiplication measurements and health physics control procedures are summarized. (W.D.M.)

12262 JAERI-1003-E

Japan. Atomic Energy Research Inst., Tokyo.
OPERATING CHARACTERISTICS OF JRR-1. Apr. 1958. 43p.

JRR-1, a 50 kw homogeneous solution type reactor, reached criticality on Aug. 27, 1957, and operated approximately 580 kwh by the end of the year. Operating characteristics are given along with information on control rod calibration, coefficients of reactivity, neutron and gamma intensity distributions, power calibration tests, etc. (W.D.M.)

12263 JAERI-1003-F

Japan. Atomic Energy Research Inst., Tokyo.
CONTROL SYSTEM OF JRR-1. Apr. 1958. 43p.

Important instruments in the JRR-1 control system including neutron detectors, flow meter, temperature measuring instruments, pressure meters, radiation monitors, and alarm circuits are described. The control system and its operational characteristics are briefly discussed. (W.D.M.)

12264 JAERI-1004

Japan. Atomic Energy Research Inst., Tokyo.
ABSOLUTE MEASUREMENTS OF NEUTRON FLUX IN
JRR-1. Kasuke Takahashi, Munemaro Imai, and
Yohmei Katoh. Sept. 1958. 9p.

For the purpose of the power calibration test of the Japanese Research Reactor No. 1, absolute measurements of thermal neutron flux in the core of the reactor were carried out using the method of neutron-induced activity of gold foils. The induced activities of Au^{198} were measured with the β - γ coincidence method and the β -ray counting method using a 4π flow counter, and the results obtained by these two methods coincide with each other within experimental errors. The maximum value of thermal neutron flux at the core center of JRR-1 calculated from these results was $1.2 \times 10^{12}/n/cm^2/sec$ at 50 kw. Results were also applied to the power calibration test of JRR-1. (auth)

12265 NDA-014-189

Nuclear Development Corp. of America, White Plains, N. Y.
CALCULATION OF THE REACTIVITY EFFECT OF
CONTROL ROD MOVEMENT IN THE ENRICO FERMI
REACTOR. J. H. Ray. Oct. 1, 1957. 19p. \$3.30(ph),
\$2.40(mf) OTS.

Two-dimensional multigroup problems were prepared and solved to determine the effect on reactivity of control rod movement in the Enrico Fermi Reactor. Part of the problems were designed to investigate the effect

of safety rod movement, while others were designed to examine the effect of shim rod movement. In addition, the effect of rod movement was calculated by hand using a set of danger coefficients for this reactor. (auth)

12266 NP-7368

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. POST-NEUTRON MEASUREMENTS AND CALIBRATION PROCEDURES FOR THE AIR FORCE NUCLEAR ENGINEERING TEST REACTOR (thesis). Albert Nelson Tardiff. Mar. 1959. 117p.

A discussion of the distributed poison method for calibrating control rods and a detailed procedure for calibrating the group rod (all rods acting together) and individual control rods by this method are presented. A method of determining the thermal neutron absorption cross section of the core by use of the inhour equation and the distributed poison method is discussed. Methods of determining the reactivity worth of the core test facilities and components are described. The reactivity worth of the large test cells, beam tubes, bulk shielding facility, fuel element positions, beryllium reflector pieces, and the cadmium curtains are measured by adding or removing poison from the core and by movements of the control rods acting as a group or individually. The other measurements discussed include the shutdown capability of the two least effective control rods, fuel weighting factor for each core position, the temperature coefficient and the void coefficients using magnesium strips to displace the coolant in the core. A few comments are made about the thermal and fast flux measurements to be accomplished during the calibration phase of the AFNETR. (auth)

12267 NP-7402

Mine Safety Appliances Co., Callery, Penna. RADIOACTIVE LEAK EXPERIMENT. Progress Report 8 [for] April 1 to April 31, 1955. Memo Report 82. R. J. Campana and J. W. Mausteller. May 3, 1955. 26p. Contract NObs-65426.

A pipe pinhole leak under lagging was performed with the system at 550°F and 1950 psig. The experiment was divided into three phases: leaking at 14.1 lph under lagging, leaking at 12.3 lph with no lagging, and no leak while fall-out of the air activity was followed. The lagging held up well under the leak conditions, and reduced the equilibrium air activity by a factor of 700-800 when adjustment was made for activity of the leaking water. About 36% of the leaked activity was retained in the lagging, and 51% was caught in the lagging drippings during leakage. An exponential air activity fall-out was found, with an average coefficient of 0.212 hr^{-1} . There was some decontamination across the leak hole. (For preceding period see NP-5733.) (auth)

12268 NP-7405

Mine Safety Appliances Co., Callery, Penna. RADIOACTIVE LEAK EXPERIMENT. (Run 7). Progress Report No. 9 [for] May 1 to May 31, 1955. Memo Report 85. R. J. Campana, J. W. Mausteller, H. E. Cummings, Jr. June 22, 1955. 18p. Contract NObs-65426.

Water contaminated with $\text{Na}_2^{24}\text{CO}_3$ has been leaked into lagging through a 7 mil diam. hole in a pipe wall from a loop operating at 2000 psig and 550°F. The experiment was divided into three parts: leaking at 6.69 lph under lagging, leaking at 6.38 lph with no lagging, and no leak while fall-out of air activity was observed. Steam collecting between the insulation and the asbestos cloth covering caused the lagging to blister and finally to

split in two places. Specific air activity during the lagged leak was attenuated by a factor of 30 until the covering split and by 15 afterward compared to the non-lagged leak. About 72% of the leaked activity was retained in the lagging and 24% was caught in the lagging drippings. An average exponential air activity fall-out coefficient of 0.252 hr^{-1} was found. (For preceding period see NP-7402.) (auth)

12269 NP-7411

Mine Safety Appliances Co., Callery, Penna. RADIOACTIVE LEAK EXPERIMENT. (Runs 9-10). Progress Report No. 11 [for] August 15 to September 30, 1955. Memo Report 93. R. J. Campana, J. W. Mausteller, and H. E. Cummings, Jr. Oct. 10, 1955. 15p. Contract NObs-65426.

Runs 9 and 10 were 12.5 hr and 18.5 hr leaks at 2.0 and 0.8 lph, respectively, through the steam packing of a 1 in. globe valve in a 500°F, 2000 psig water loop contaminated with $\sim 30 \text{ mc}$ of $\text{Na}_2^{24}\text{CO}_3$. The leak periods were followed by observation of fall-out of air activity for 29.25 and 16.75 hr, respectively. Maximum specific air activities of 2 and $3 \mu\text{c}/\text{ml}$ were found in Runs 9 and 10, respectively. Fall-out coefficients were 0.187 hr^{-1} for Run 9 and 0.363 hr^{-1} for the first 5 hr and 0.159 hr^{-1} for the following 12 hr of Run 10 fall-out. The material balance was of questionable accuracy but qualitative results indicate substantial hold-up of activity in the valve packing rings. Indications are that the valve packing attenuated the air activity by a substantial factor, probably equivalent to attenuation by the insulation of lagged pipe leaks. (auth)

12270 NP-7416

Mine Safety Appliances Co., Callery, Penna. RADIOACTIVE LEAK EXPERIMENT. (Run 11). Progress Report No. 12 [for] September 15 to September 30, 1955. Memo Report 99. R. J. Campana, J. W. Mausteller, and H. E. Cummings, Jr. Dec. 21, 1955. 11p. Contract NObs-65426.

Run 11 was a leak test in two parts: 9 and 3 hr leaks at 15.5 and 17.0 lph, respectively, through a 10 mil diameter hole in an uncovered pipe of a 500°F, 2000 psig water loop contaminated with $\sim 270 \text{ mc}$ of Mo^{99}O_3 . The chief purpose of this run was to determine activity distribution as a function of particle or droplet size distribution. A cascade impactor was employed to separate the particles into four ranges: 0.4 to 0.7, 0.7 to 2.0, 2.0 to 6.0, and 6.0 to 18μ effective diameter. The activity found was 85, 13, 2, and 0%, respectively, for the above ranges. Photomicrographs of deposits showed only solid particles were found and no droplets. Maximum specific air activities reached an equilibrium value of $600 \mu\text{c}/\text{ml}$ $\sim 5 \text{ hr}$ and a value of $692 \mu\text{c}/\text{ml}$ when terminated 3 hr after the start of the second leak period. The run was terminated when an uncontrolled leak appeared in one of the shut-off valves. No fall-out, wall activity or material balance data were obtained. (For preceding period see NP-7411.) (auth)

12271 NP-7417

Mine Safety Appliances Co., Callery, Penna. RADIOACTIVE LEAK EXPERIMENT. (Run 12). Progress Report No. 13 [for] October 1 to October 31, 1955. Memo Report 102. R. J. Campana and H. E. Cummings, Jr. Jan. 3, 1956. 11p. Contract NObs-65426.

Run 12 was a 3.5, 66, and 10 lph leak for 5, 1, and 8 hr, respectively, through the teflon-impregnated asbestos packing of a 1 in., 2500 psig valve in a 500°F, 2000 psig water loop contaminated with $\sim 188 \text{ mc}$ of Mo^{99}O_3 .

The run was a comparison test of similar leaks using $\text{Na}_2^{24}\text{CO}_3$ as the contaminant (Runs 9 and 10). A maximum air activity of $\sim 24 \mu\text{c}/\text{ml}$ was found at 3.5 lph leak rate. Air activity normalized for concentration of the leaking water at 10 lph exceeded that at 3.5 lph, but at 66 lph the air activity was suppressed. An air activity attenuation factor of ~ 25 was found using a bare pipe leak as a standard and compares well with those found using Na-24 . A fall-out factor of 0.29 hr^{-1} was observed. Only 0.22% of the leaked activity was found in the packing rings. Wall activity was ~ 100 times that found with Na and the decontamination factor was only 1.2, approximately $\frac{1}{3}$ that found with Na. Air activity appears to depend on the rate of solid particle formation for which the optimum conditions seem to be at some intermediate leak rate. (For preceding period see NP-7416.) (auth)

12272 NP-7419

Mine Safety Appliances Co., Callery, Penna.
RADIOACTIVE LEAK EXPERIMENT. (Run 13). Progress Report No. 14 [for] November 1 to November 30, 1955. Memo Report 104. H. E. Cummings, Jr., R. J. Campana, and J. W. Mausteller. Feb. 3, 1956. 12p. Contract NObS-65426.

Run 13, using 63.5 mc of Na^{24} and 152.0 mc of Mo^{99} as simultaneous contaminants of a 550°F, 2000 psig water loop, was a comparison test with similar leaks using single tracers. The run included an erratic $3\frac{1}{4}$ hr leak at 3 lph through a 7 mil diameter hole in a lagged pipe, a $4\frac{1}{2}$ hr leak at ~ 16 lph through the loop drain valve, started when the 7 mil pipe hole plugged and could not be opened, and a $\frac{1}{4}$ hr blow down through the drain valve seat at 200 lph during which the temperature was allowed to fall to 520°F and the pressure to atmospheric. Maximum air activity of $167 \mu\text{c}/\text{ml}$ was reached at $3\frac{1}{2}$ hr of valve, seat leak and consisted of maximum values of $97 \mu\text{c}/\text{ml}$ of Na^{24} and $70 \mu\text{c}/\text{ml}$ of Mo^{99} activity. Na^{24} and Mo^{99} activities followed closely the variations of the total activity with an average of 60% of the total attributable to Na^{24} . Only 30% of total autoclave and loop water activity came from Na^{24} . Air activity levels, corrected for the activity concentration the leaking water, show a ratio of 3.2/1 Na^{24} to Mo^{99} but the reasons for preferential Na contamination are not known. Suppression of the air activity at 200 lph was observed as noted for large leak rates in previous runs. A comparison with individual isotope behavior from prior runs would be meaningless because of the type of leak which had to be used. Run 14 should give some information of this type. (For preceding period see NP-7417.) (auth)

12273 NRL-5270

Naval Research Lab., Washington, D. C.
MAN-MACHINE FACTORS IN THE NRL NUCLEAR REACTOR CONTROL SYSTEM. H. J. Berliner, M. P. Young, and G. F. Wall. Dec. 24, 1958. 22p. Project No. NR-401-000.

One important problem in the design of a research reactor is the allocation of control responsibility among men and automatic equipment so as to achieve the maximum in safety, flexibility, and continuous operation. To meet these objectives, the design planning for the NRL Research Reactor control system included careful consideration of the relative advantages and limitations of men and machines for each of the required control functions. For example, the operator has been assigned the primary controlling task, but he is given the option of turning over to the automatic equipment the routine task

of maintaining reactor power level at a constant value. In addition, the operator's controlling behavior is restricted by the system of automatic alarms which warns him to take corrective action whenever reactor operation will lead to unsafe conditions. Thus, man's ability as a general-purpose computer capable of dealing with low-probability alternatives is utilized to institute appropriate corrective action before automatic shutdown is enforced. To facilitate the operator's task, he has displays which provide him with continuous, concise information, and controls which allow prompt action on the basis of this information. Indicators which display equipment conditions on the outside of cabinets make diagnosis easier in case of equipment trouble. Replacement and maintenance are lightened by having plug-in type replacement chassis, nearby repair shops, and ample servicing access space. (auth)

12274

CONTROL RODS FOR POWER REACTORS—IS SPEED A PROBLEM? Paul Braffort and Jacky Weill (French Atomic Energy Commission, Paris). Control. Eng. 6, No. 5, 101-5(1959) May.

An analysis of reactor control rod speed criteria is presented. It is shown that in most cases safety requirements determine the proper speeds. Temperature and flow changes are so heavily damped in comparison to the nuclear power that an increase in rod speed beyond that normally required adds nothing to the turbine response, and in general can be limited to $10^{-6} \Delta k/\text{sec}$ for starting and compensating rods, and $2 \times 10^{-4} \Delta k/\text{sec}$ for coarse-regulating rods, where Δk represents the multiplication constant of the core material. (J.R.D.)

12275

STATISTICS OF NUCLEAR REACTORS OF THE WORLD. [PART] I. G. Gandusio. Energia nucleare (Milan) 6, 1-66(1959) Jan. (In Italian)

In the first part of the article, the principle features of reactors which have reached criticality are tabulated. (J.S.R.)

12276

AN EXTREMELY HIGH THERMAL FLUX REACTOR. M. Osredkar. "J. Stefan" Inst. Repts. (Ljubljana) 4, 77-83(1957).

An assembly was investigated to see the possibility of achieving extremely high thermal flux. It has been found that an assembly with a heavy water central zone, a light water layer, an absorbing layer, and a fast reactor core would have the ratio of maximum thermal flux to maximum heat release $\Phi_{\text{th}}/P_m = 10^{13}$, which means that having a cooling rate of 1000 kw/l, a thermal flux of 10^{16} neutrons/sec/cm² sec can be achieved. Even if fast reactors are difficult to handle, for the purpose of achieving an extremely high thermal flux, a fast assembly can be expected to be more advantageous than a thermal high flux reactor. (auth)

12277

TWO-GROUP CALCULATION OF THE TEMPERATURE DEPENDENCE OF THE PHYSICAL PARAMETERS OF THE LIGHT WATER HOMOGENEOUS REACTOR. A. Peterlin and R. Kladnik. "J. Stefan" Inst. Repts. (Ljubljana) 4, 85-8(1957).

The homogeneous reactor with UO_2SO_4 (20% enrichment) in light water can be safely controlled and shut-down by varying and eventually emptying the reflector container in the temperature interval from 25 to 250°C.

At 200°C there is still a net margin for the heat removal by free boiling of the active solution. (auth)

12276

THE SPHERE SECTOR REACTOR. A. Peterlin. "J. Stefan" Inst. Repts. (Ljubljana) 4, 89-93(1957).

The geometrical buckling of the conical sphere sector for different cone angles was calculated. The height of the shell is given as function of the radius of the inner smaller basis. The volume of the critical reactor does not differ very much from that of a cylindrical reactor of the same height. (auth)

12279

ESTIMATION OF THE HEATING OF THERMAL NEUTRONS IN THE FUEL ELEMENTS OF HETEROGENEOUS REACTORS. Albert Müller (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonik 1, 172-4(1959) Apr. (In German)

In heterogeneous reactors the thermal neutron spectrum during absorption in fuel elements is different from the spectrum in the moderator since the neutrons coming from the moderator were "heated up" by scattering collisions in the hot fuel elements in the core. A formula was derived which permits an estimation of this heating when the average energy transfer to a thermal neutron in scattering by liquid and crystalline substances is sufficiently well known. (tr-auth)

12280

CELL CALCULATION FOR A HETEROGENEOUS REACTOR BY THE THREE GROUP DIFFUSION THEORY. H. Ritz (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonik 1, 175-82(1959) Apr. (In German)

The analytical solution of the three-group diffusion theory for multi-layer cylindrical arrangements was stated for the calculation of the neutron flux density distribution and single flux function. The numerical calculation was carried out for the cell of a D₂O reactor divided into three zones. In addition to the neutron distribution, the multiplication factor k_{∞} of the infinite arrangement was given. The factor for fast fission and the resonance capture p were presented according to their exact definition, since the epithermal fission in U²³⁵ was considered also. The results were compared with those from one-group calculations. (tr-auth)

12281

BASIC PHYSICAL CALCULATIONS FOR A HEAVY WATER REACTOR WITH NATURAL URANIUM. Ladislav Trlifaj and Ivan Ulehla. Rozprawy Českoslov. Akad. věd, Řada mat. a přírod. věd 67, No. 11, 52s (1957). (Translated from Referat. Zhur. Fiz. No. 6, 1958, Abstract No. 12785.)

One-group diffusion calculations are presented for a natural-uranium-fueled, heavy-water-moderated, and graphite-reflected reactor. (W.D.M.)

12282

REACTOR CORE MATERIALS. Technical Progress Reviews, Vol. 1, No. 4. Columbus, Ohio, Battelle Memorial Institute, 1958. 47p. \$0.55(GPO) domestic; \$0.70(GPO) foreign

Mechanical-property data on beta-heat-treated and irradiated U are tabulated, and conclusions from investigations on U swelling under irradiation are listed. Results of a corrosion investigation of high alpha U alloys measured by weight loss are given, as well as results of air oxidation tests of U-Nb alloys and water

corrosion data for Nb-U-Zr alloys. Conclusions drawn from Bettis corrosion tests of Zircaloy-base fuel alloys in high-temperature water are given. Preparation of Pu alloys is discussed along with a review of work with Th alloys and dispersion-type fuel elements. Data on UO₂-containing ceramics are presented emphasizing the effects of C addition on sinterability. Moderator materials such as Be and Be alloys are examined, and data on coextrusion of Be and U are presented. In addition, Zr hydrides were studied, and a graph showing the variation of lattice parameters, axial ratio, and the volume as functions of temperature is presented. Also graphs of the isotherms in the Nb-H system are included. Tables of the heats of solution of the Nb-H system are given. Data on control rod alloys are listed, including tensile properties of Hf, mechanical properties of Ag-In-Cd alloys, and corrosion of rare earth alloys. Corrosion of cladding materials such as Zr, stainless steel, Nb, Mo, Ta, and Ni-base alloys is discussed, and data on carburization of Inconel and Inor-8 are given. Data on selected mechanical properties of Zr and Zr alloys are tabulated. Included are tensile properties at room temperature as well as at 250 and 350°C for Zircaloy-2 and -3. Mechanical properties of Ni-base alloys with Mo, Cr, and Fe are listed with the emphasis on Inor-8. Development of special fabrication techniques is reported including information from a study of the factors which affect the quantities of nonmetallic impurities in vacuum-melted U. Also reported is information on development of roll cladding, pressure bonding, and coextrusion of Zircaloy-clad U fuel elements. Information on U joining methods is presented, and data on physical properties of welded U are listed. Applications and developments in nondestructive testing are reviewed. (J.R.D.)

12283

VENTILATION OF RESEARCH NUCLEAR REACTOR BUILDING. John Dolio (Shaw, Metz & Dolio, Chicago) and Ernest W. Landow (Argonne National Lab., Lemont, Ill.). p.359-74 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

The ventilation system design for Argonne National Laboratory's CP-5 Reactor building is described. (W.D.M.)

Power

12284 AECU-3782

Allis-Chalmers Mfg. Co., Milwaukee. PATHFINDER ATOMIC POWER PLANT TECHNICAL PROGRESS REPORT FOR APRIL 1, 1958-JUNE 30, 1958. June 30, 1958. 70p. Contract AT(11-1)-589. For Northern States Power Co. and Central Utilities Atomic Power Associates. (ACNP-5811). \$2.00(OTS).

Progress is reported on fuel element development, reactor mechanical studies, nuclear analysis, chemistry, control, safety, feasibility, steam cycle, and materials and metallurgy. (For preceding period see AECU-3683.) (T.R.H.)

12285 AECU-4075

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

THE ARMOUR DUST FUELED REACTOR (ADFR).

Final Report Covering the Period February 21, 1958 to

February 21, 1959. D. Krucoff. 69p. ARF Project A-115. Contract AT(11-1)-603. \$10.80(ph), \$3.90(mf) OTS.

Dust circulation studies were conducted in a 2-in.-diam. glass tubing loop, 5 x 5 ft, at gas velocities of 100 and 150 fps. Most of the studies were done with Al_2O_3 in air, but some were done with UO_2 in N_2 . Two-group criticality calculations for a graphite-reflected and moderated U^{235} burner gave approximate values of core size and fuel concentration. Investigation of axial variations in fuel density indicate that the axial neutron flux and power distributions deviated from the usual cosine distributions, but the effect on critical mass is small. The safety of the system in the event of large, sudden injections of fuel dust into the core was studied using a simplified model of the gas dynamics. Breeding blanket requirements were examined for a fluidized-bed-type blanket. (See also AECU-3828.) (T.R.H.)

12286 AECU-4094

Atomic Power Development Associates, Inc., Detroit. BASIC CONCEPT OF THE INERT GAS SYSTEM FOR PRIMARY SODIUM. Technical Memorandum No. 9. W. W. Kendall and W. L. Chase. Feb. 3, 1958. 33p. Contract [AT(11-1)-476]. \$6.30(ph), \$3.00(mf) OTS.

The design values which were selected and the reasons for selecting them are given for the Fermi Reactor inert gas system. The concept of the system which is to be used to prepare the detailed flow sheet and to design the system components is described. The gas is to be either helium, argon, or nitrogen. (W.D.M.)

12287 AECU-4095

Atomic Power Development Associates, Inc., Detroit. SHIELDING ON 30-INCH PIPE. Technical Memorandum No. 10. John J. Morabito. Feb. 5, 1958. 9p. Contract [AT(11-1)-476]. \$3.30(ph), \$2.40(mf) OTS.

The materials of construction and the design of the shielding for a 30-inch pipe are presented. A calcium borate and a borated diatomaceous earth-luminite concrete performed equally satisfactorily and both are considered for the shielding of the pipe. (W.L.H.)

12288 AECU-4096

Atomic Power Development Associates, Inc., Detroit. DESCRIPTION OF THE INERT GAS SUPPLY SYSTEM. Technical Memorandum No. 11. W. L. Chase. Mar. 7, 1958. 6p. Contract [AT(11-1)-476]. \$1.80(ph), \$1.80(mf) OTS.

A description of the inert gas supply system for the Fermi Fast Breeder Reactor is presented. Design conditions are given and the supply and purification arrangements are discussed. (W.D.M.)

12289 AECU-4097

Atomic Power Development Associates, Inc., Detroit. LEAKAGE FROM INERT GAS SYSTEM. Technical Memorandum No. 14. W. W. Kendall and W. L. Chase. Apr. 4, 1958. 7p. Contract [AT(11-1)-476]. \$1.80(ph), \$1.80(mf) OTS.

Leakage of inert gas into the containment building is examined from the standpoint of sources and rates. Methods of calculating maximum permissible leak rates are presented as well as graphs showing permissible total leak rate as a function of building ventilation. The ventilation system described covers only radioactive requirements. (J.R.D.)

12290 AECU-4098 and ADD. 1

Atomic Power Development Associates, Inc., Detroit. REACTOR BUILDING VENTILATION. Technical

Memorandum No. 17. R. B. Shumaker. Oct. 3, 1958. 14p. ADDENDUM 1. Dec. 8, 1958. 9p. Contract [AT(11-1)-476]. \$4.80(ph), \$2.70(mf) OTS.

This report and addendum 1 were issued separately, but are cataloged as a unit.

A review is presented of the Fermi Power Plant building heating, cooling, and ventilation. The heating and cooling loads and operation pressures in the areas above and below the operating floor are summarized. Design features such as ventilation rate and operation of shut-off valves are included. (W.L.H.)

12291 ANL-5733

Argonne National Lab., Lemont, Ill. REACTIVITY TRANSIENTS AND STEADY-STATE OPERATION OF A THORIA-URANIA-FUELED DIRECT-CYCLE LIGHT WATER-BOILING REACTOR (BORAX-IV). B. S. Maxon, O. A. Schulze, and J. A. Thie. Feb. 1959. 78p. Contract W-31-109-eng-38. \$1.50(OTS).

A series of experiments involving rapid ejections of a control blade from low power levels were done at room temperature and 207°F to obtain information about the inherent self-limiting capabilities of light water-boiling reactor systems. Periods down to 83 msec were self-terminated without core damage. Theoretical analysis showed that the power excursion data could be correlated by a single energy coefficient of reactivity: $0.029 \pm 0.001\%$ reactivity/Mw-sec. Steady-state boiling experiments at pressures ranging from atmospheric pressure to 322 psig gave powers up to 4.6 Mw for the former, and 20.5 Mw for the latter, pressure. A reactivity in steam voids of 6.9% was achieved at 322 psig; the corresponding power density was 45 kw/liter of core. Information on reactor stability was obtained from measurements of transfer function using a rod oscillator. A sharp resonance was observed, and values of the resonant transfer function obtained were as much as seven times higher than the mid-frequency zero-power transfer function. Theoretical analysis revealed the resonating transfer functions were due to a feedback whose magnitude was of the order of reactivity in steam voids, and whose phase was determined by time constants of the same order as that of the fuel and the steam bubbles. Computations based on the theoretical initial conversion ratio for U^{233} show that 71 gm U^{233} were produced as a result of intermittent experimental operation for one year, equivalent to 300 Mwd. (auth)

12292 APAE-44

Alco Products, Inc., Schenectady, N. Y. SHORT-LIVED AND FISSION PRODUCT ACTIVITY IN THE SM-1 PRIMARY COOLANT. Final Report. Task III. William S. Brown and Robert A. Hasse. Mar. 10, 1959. 97p. Contract AT(30-3)-326. \$12.30(ph), \$4.50(mf) OTS.

The primary coolant of the SM-1 (APPR-1) was analyzed for short-lived and fission product activities. Manganese-56 was found to be the predominant non-fission product nuclide contributing to the short-lived activity. Fission products were found in the coolant. It is concluded these fission products originate from a defect(s) in the cladding and from surface contamination of the fuel elements. (auth)

12293 BNL-2463

Brookhaven National Lab., Upton, N. Y. THE LIQUID METAL FUEL REACTOR FOR CENTRAL STATION POWER. Donald J. Sengstaken and Edwin Durham. [1955]. 32p. \$6.30(ph), \$3.00(mf) OTS.

A central station nuclear steam power plant employing the Liquid Metal Fuel Reactor, developed at Brookhaven National Laboratory, was designed by a group of utility and power apparatus engineers working at the Laboratory. Using high temperature liquid bismuth as the fuel and breeder blanket carrier, the LMFR couples the advantages of high cyclic efficiency and continuous fuel and blanket processing to produce competitive nuclear power. Steam produced in forced flow, once-through boilers enters the 200 Mw turbine generator at 1250 psig at 900°F. The presentation includes descriptions of the liquid metal fuel and blanket systems, plant and piping layouts, control schemes, cost estimates, and descriptions of both normal and emergency operation. (auth)

12294 CF-59-4-86

Oak Ridge National Lab., Tenn.

THE ECONOMICS OF NUCLEAR POWER. James A. Lane. Apr. 27, 1959. 30p. Contract [W-7405-eng-26]. \$4.80(ph), \$2.70(mf) OTS.

Economic aspects of nuclear power development in the U. S. are tabulated and graphed. Included are figures on presently operating reactors as well as those contemplated or scheduled. Also a brief description of the objectives of short- and long-range programs is given as well as tables listing some of the characteristics of each reactor. (J.R.D.)

12295 KAPL-M-JRB-8

Knolls Atomic Power Lab., Schenectady, N. Y. SOME RESULTS OF TESTS AND OBSERVATIONS OF THE S3G FEEDWATER CONTROL SYSTEMS. J. E. Barnes, Jr., W. P. Crownover, and D. R. MacNaughton. Apr. 22, 1959. 19p. Contract W-31-109-Eng-52. \$6.30(ph), \$3.00(mf) OTS.

A method of adjusting the Three-Element Feed Controller and the Hagan Feed Pump Controller is recommended. One important result of study and observations is that for each boiler there is a proper balance of gain setting in the Three-Element Feed Controller which effectively decouples the two controllers. (auth)

12296 MND-E-1744

Martin Co. Nuclear Div., Baltimore.

ERDL CORE EXTRAPOLATION EXPERIMENTS; DESIGN OF EXPERIMENTS. Task 103, Phase 1. T. M. Olsen, L. Welshans, and W. E. Osmeyer. Mar. 1959. 68p. Contract DA-44-009-ENG-3318.

The analytical design is described of a critical experiment for investigation an APPR-type core with a nominal loading of 45 kg of U^{235} . The experiment will show the effects of boron loading and fuel plate thickness on total core reactivity at this loading. Nine cores will be studied; three boron loadings, three plate thicknesses for each boron loading. Analytical predictions of experimental results, hazards analyses, and the experimental program design are included. (D.E.B.)

12297 NAA-SR-Memo-1438

North American Aviation, Inc., [Downey, Calif.].

THERMAL STRESSES IN LONG THIN-WALLED CYLINDERS DUE TO AN AXIAL TEMPERATURE GRADIENT. C. H. Robbins. July 19, 1955. 11p. \$3.30(ph), \$2.40(mf) OTS.

Stress equations and curves are presented for thermal stress in long thin-walled cylinders due to an axial temperature distribution described by $t = F(1 - e^{-bx})$ for $x > 0$ and $t = -F(1 - e^{-bx})$ for $x < 0$. The solution was obtained to aid in the design of the SRE core tank. Results presented are applicable to a wide range of cases. (auth)

12298 NAA-SR-Memo-1798

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

PERFORMANCE OF THE SRE PROTOTYPE COLD TRAP ASSEMBLY. M. E. Nathan. Dec. 7, 1956. 28p. \$4.80(ph), \$2.70(mf) OTS.

Analysis is presented of the performance of the SRE prototype cold trap assembly recently tested at the Santa Susana Tower Facility. Problems in maintaining a controlled rate of oxygen addition to a circulating sodium stream are discussed. Test data for equilibrium periods of oxygen addition to the cold trap test loop are presented which indicate that the prototype cold trap retained essentially 100% of the Na_2O precipitated in the design sodium throughput stream of 1350 lbs/hr. In addition, a discussion and recommendations are presented concerning operation of the cold traps in the SRE. (auth)

12299 NP-7385

[Japan. Atomic Energy Research Inst., Tokyo.]

NUCLEAR CALCULATION FOR LIGHT WATER MODERATED REACTOR. [Report] No. 4. Jitsuya Hirota, Toshiyuki Kuroyanagi, Kazuhiko Inoue, Hiroshi Takahashi, and Satoru Katsuragi. Mar. 1958. 46p.

Calculation methods are presented for light water cooled and moderated power reactors. Three and four group theory are used taking into account the effect of epithermal fission. Results on four factor, multiplication factor, Fermi age and buckling of UO_2 fueled reactors, effectiveness of control rods, and long term reactivity changes are given. (W.D.M.)

12300 ORNL-2696

Oak Ridge National Lab., Tenn.

HOMOGENEOUS REACTOR PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1959. Apr. 16, 1959. 240p. Contract W-7405-eng-26. \$4.00(OTS).

Homogeneous Reactor Test. Completion of the inspection and maintenance activities which followed run 17 in the Homogeneous Reactor is reported. Reactor run 18 was designed to study the problems of fuel instability as indicated by loss of circulating U, sudden power excursions, or gradual changes in the composition of the fuel solution. These three factors were observed closely over the 1200-hr (350 Mwhr) operating period of run 18 and results are reported. In the HRT Processing Plant three hydroclone loop runs have been completed. Solids removal rates were slightly higher than in previous runs. The rotor of the circulating pump locked during rinse operations following the first 106-hr run. Values of total Zr corrosion through run 17 were calculated. In the first 106 hr 273 g of corrosion products were collected. Calculations indicate that small deposits of U on the core wall could lead to melting of the Zr in contact with the U. The power response of the HRT following a reactivity addition has been calculated for various initial powers. The critical mass of HRT-type reactors was calculated for various core diameters and H_2O-D_2O compositions. The effect of core and blanket temperature upon critical concentrations for HRT-type reactors containing only moderator in the blanket is described. Preliminary cost estimates are reported for an HRT replacement reactor-vessel assembly. Testing of four prototype HRT feed and purge pump heads was continued. The HRT mockup, while continuing the test of a Ti pressurizer and feed heater was operated on a fuel composition of 0.045 m UO_2SO_4 -0.036 m $CuSO_4$ -0.025 m H_2SO_4 . A 0.021-inch-thick feed-pump diaphragm

failed after 12,153 hr of operation. Reactor Analysis and Research. The effects of core-vessel thickness on the ratio of U^{238} to Th required for criticality and the reactivity worth of the reflector were calculated for several slurry-core reactors. The amount of natural B required to decrease the critical temperature from operating conditions to 20°C was calculated for three slurry reactors. Heat transfer under nucleate-boiling conditions was studied for ThO_2-H_2O slurries containing up to about 1000 g of Th per liter. Thoria caking studies are reported. The stress in a two-radii contour diaphragm pump was calculated as a function of the ratio of the two radii. Engineering Development. The performance of various centrifugal pumps under various test conditions is reported. Tests on bearings and shaft seals are presented. The operational testing of feed pumps is described. Operation of the 200A loop and construction and preoperational testing of the 200B slurry loop are presented. The handling characteristics, rheological properties, attack rate, and stability of mixed ThO_2-UO_2 slurry under anticipated reactor conditions were examined. The 30-inch-diameter experimental pressure vessel is being installed in the 300-SM loop for the study of slurry behavior under re-entrant flow at reactor operating temperature and pressure. Tests were continued on the measurement of slurry density by means of gamma-ray transmission. Reactor Materials Research. A number of tests were made to study the deposition of U, Cu, and Ni sulfates from dilute fuel solutions circulated through a heated Zircaloy-2 pipe section in the 100A pump loop. Two different hydroclone mountings on a 100A loop have been tested to determine effectiveness of each mounting in removing corrosion products from the loop. Chemical stability tests were run at 300°C on a solution containing $UO_2SO_4-Li_2SO_4-D_2SO_4-CaSO_4$. The addition of F^- to oxygen- and chloride-containing phosphate-treated boiler water did not suppress stress-corrosion cracking of type 347 stainless steel. Zircaloy-2 was practically unaffected by the heavy phase of a UO_2SO_4 solution. In 100-hr tests at 250°C, Ti was not corroded by oxygen-free UO_2SO_4 solutions. Dynamic corrosion and slurry-property data are reported for four tests in 100A pump loops; two were carried out to evaluate slurries of two ThO_2 preparations proposed for an in-pile slurry-loop program. Inclusion of substantial proportions of UO_2 in ThO_2 reduced corrosion of various metals. The normalized corrosion rate of Inconel under oxygen atmosphere and with ThO_2 containing no UO_2 was 12 mpy. Two HB-6 type rocking autoclave experiments were prepared and operated in the LiTR in order to obtain radiation-corrosion data for ThO_2 slurries. Scouting type experiments were made with solution 1 to determine whether deposition of U in the loop core could be produced at low overpressure with the 0.3-fps flow rate. An electrochemical method was used to determine the rate of oxidation of Zircaloy-2 in H_2SO_4 . Metallurgical specimens cut from the screens of the HRT core tank have been examined macroscopically and microscopically. A minor loss of ductility was found in Ti samples exposed in the blanket region of the HRT. Experiments in welding the tube-to-header joints with Inconel-clad type 347 stainless steel components have shown a need for a barrier pass between the Inconel and stainless steel layers. The amenability of Zircaloy-2 to fabrication into hemispheres by spinning has been demonstrated. Attempts to detect embrittlement in welds of Ti or Zr by ultrasonic measurements was unsuccessful. The oxygen

pressure required for ignition of Ti samples was shown to be temperature dependent. The hardness of irradiated steels has been measured after post-irradiation annealing. Stainless steel and Zircaloy-2 pins immersed in simulated, boiling HRT solution showed evidence of attack. In hydrogen-oxygen mixtures the concentration of hydrogen at which an explosion will be propagated through a charcoal bed was determined. Several reagents were successfully used for removal of radioactive oxide scale from HRT pipe specimens. Three short-term slurry irradiation tests were carried out in the LiTR at 300°C to evaluate low-fired ThO_2 and their palladium oxide catalyst preparations. In out-of-pile studies, to develop a catalyst for the internal recombination of radiolytic D_2 and O_2 in a reactor slurry, pumping under O_2 impaired the catalytic of a slurry of 1600°C-fired oxide containing a MoO_3 catalyst. An investigation of the use of boric acid as a soluble poison in fuel slurries to control criticality is under way. Supporting Chemical Research. Phase studies are reported for the system $UO_3-CuO-NiO-SO_3-H_2O (D_2O)$. Analytical Chemistry. A method was devised for the determination of U^{4+} in mixtures of ThO_2-UO_2 which contain from 3 to 30% U. (For preceding period see ORNL-2654.) (W.L.H.)

12301 WAPD-PWR-TE-28

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

DECAY HEAT REMOVAL SYSTEM. Test Evaluation DL-S-173 (T-612105). W. J. Hahn. Oct. 24, 1958. 20p. \$4.80(ph), \$2.70(mf) OTS.

A test was performed to evaluate the design of the PWR decay heat removal system by determining its ability to protect the reactor core from damage during an emergency shutdown caused by loss of electrical power to the reactor coolant pumps. The reactor plant was operated for approximately 100 hours at full rated output of 60 Mw. At the end of this period the generator was shut down by automatic closure of the turbine throttle valves caused by a loss of condenser vacuum. The control rods were then inserted at the maximum controlled rate to the bottom programming limit. When the rods reached the point where the reactor could be considered to be subcritical, the reactor coolant pumps were stopped, simulating a loss of power. When the pumps were stopped, the d-c motor-operated valve which normally isolates the decay heat relief valve opened automatically. This sequence of events took approximately 18 minutes. During this time decay heat was being generated and distributed throughout both the reactor coolant and steam systems. No attempt was made to dissipate this heat. The flowrate calculated from the test data was slightly less than predicted. However, these observed flows are subject to the inaccuracies of graphical calculations, and therefore the method used in the design calculations is considered valid. Test results indicate that the heat removal system will perform adequately in the worst case loss-of-coolant-flow accident. (A.C.)

12302 WAPD-PWR-TE-37

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. REACTOR POWER AND TEMPERATURE CONTROL SYSTEM. PERIOD II. Test Evaluation DL-S-128 (T-550082). E. G. Scroggins. Jan. 20, 1959. 12p. Contract [AT-11-1-GEN-14]. \$3.30(ph), \$2.40(mf) OTS.

A test to check the performance of the Shippingport Reactor power and temperature control system compo-

nents and circuit integrity is described. The test was to verify that nothing had been damaged during shipment or installation and that the equipment was ready for service. Test results were evaluated, and recommendations are made. (W.D.M.)

12303 WAPD-PWR-TE-44

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

RADIATION SURVEY OF REACTOR PLANT CONTAINERS AND COMPONENTS AFTER SHUTDOWN. Test Evaluation DL-S-184 (T-612076). J. R. Coulter. Dec. 1, 1958. 15p. \$3.30(ph), \$2.40(mf) OTS.

A study was made by radiation surveys of the increase in activity levels caused by the buildup of deposited radioactivity on the inside surfaces of the primary loop piping, vessels, and components during the life of the plant. The extent, distribution, and nature of plant contamination as it may exist at any time were determined. Although no definite conclusion could be drawn as to the rate of radiation level increase each time, the survey provides a base point for future surveys. (J.E.D.)

12304 WCAP-1148

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES CVTR PROJECT. Progress Report [for] February 17, 1959 to March 31, 1959. 23p. \$4.80(ph), \$2.70(mf) OTS.

Brief summaries are given of work done on various phases of reactor design and development. Limited information is reported from studies of UO_2 -pellet fuel preparation, from relative evaluations of stainless steel and Zircaloy as structural materials, and from comparisons of the mechanical properties of light and heavy water. (For preceding period see WCAP-1096.) (D.E.B.)

12305 YAEC-104

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

DARED-1—AN IBM-704 PROGRAM FOR REDUCING DATA FROM FOIL IRRADIATION AND FITTING BY LEAST SQUARES TO BESSEL J_0 OR COSINE FUNCTION. Jacek Jedruch and Carl Saalbach. Jan. 1959. 116p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. \$18.30(ph), \$6.00(mf) OTS.

A description is given of a code for the IBM-704 computer which reduces and fits by least squares the measurements of radioactivity of a sequence of foils. Corrections for background, counter deadtime, foil weight, and radioactive decay are applied, and readings outside a specified range are rejected. Errors due to statistical fluctuations are computed and off-center ordinates are calculated. Reduced data are then fitted by least squares to the best value of the arguments of Bessel J_0 or cosine functions. Up to 100 foils in a sequence can be handled, and decay times up to 999 min can be accommodated. An IBM-704 computer having 8192 words of core storage is required. No drums or tapes are needed. Running time for a typical 50 point problem involving data reduction alone is 2 min. With least squares fitting, the same problem would require 4 min. (auth)

12306 YAEC-114

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

A STUDY OF LOADING CONFIGURATIONS FOR THE

YANKEE REACTOR. H. W. Graves, Jr., W. H. Arnold, Jr., W. J. Eich, G. H. Minton, and R. E. Wolf. Apr. 1959. 61p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. \$9.30(ph), \$3.60(mf) OTS.

Three types of fuel loading configurations for the Yankee first core are described and compared with one another from the standpoint of power capability and reactivity control. These configurations are uniform loading, two enrichment loading, and two cycle loading in which new fuel is loaded in one of two annular core regions while the other region is occupied by fuel which had the same initial enrichment but has already been exposed to the neutron flux. The preliminary studies of control rod programming presented indicate that sufficient flux shaping with control rods can be obtained in a uniformly loaded core. Because of the relative simplicity of the control rod program for the uniform core it is recommended as the most desirable loading method for the first Yankee core. (auth)

12307

BELGIUM PLANS A PWR FOR EUROPE. Charles Gerard (Ateliers de Constructions Electriques de Charleroi, Centre Nucléonique, Belgium). Nuclear Power 4, No. 36, 86-91(1959) Apr.

A detailed design for a 145 Mwe pressurized water reactor was developed by the ACEC. The reactor produces 2,000,000 lb/h of saturated steam at a pressure of 500 psia. Water is returned to the boilers at a temperature of 340°F. In order to increase the steam temperature up to 1000°F at the expense of a slight pressure drop, a coal-fired superheater can be added between the boilers and the turbine. The net electrical output is accordingly increased to 240 Mw. The reactor is presently being tendered for European projects. (W.D.M.)

12308

FUEL ELEMENTS TODAY AND TOMORROW—SOME CURRENT DEVELOPMENTS. G. B. Greehough (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). Nuclear Power 4, No. 36, 92-6(1959) Apr.

A summary is presented of the symposium held in New York on Jan. 28-29, 1959, which was jointly organized by Columbia University and the Sylvania-Corning Nuclear Corporation. In the immediate future the best bet is metallic fuels, in 5-10 years UO_2 in metallic cans, and in the more distant future, graphite cladding. (W.D.M.)

12309

DRAGON, DETAILS OF THE 10 MW HTGR. Nuclear Power 4, No. 36, 102-3(1959) Apr.

The third jointly-run project of the European Nuclear Energy Agency is a 5-year study of high-temperature, gas-cooled reactors. Known as Dragon, it will consist mainly of a 10 Mwe prototype to be built at Winfrith Heath. The reactor is to be helium cooled with an outlet temperature of 750°C. The fuel elements are constructed from graphite, U^{235} , and thorium and are in a hexagonal arrangement. (W.D.M.)

12310

DUST REMOVAL IN GAS COOLED REACTORS. R. A. Le Page. Nuclear Power 4, No. 36, 104-7(1959) Apr.

After much research on high-efficiency filtration in gas circuits, the known characteristics of the Mancuna-Dustex high-efficiency miniature cyclone suggested that development of the basic cyclone tube might well provide

the best over-all solution to this problem. Tests on the cyclones indicate an efficiency of 99.87% at 600 fps. (W.D.M.)

12311

ACTIVITY BUILD-UP IN PWRs WITH STAINLESS STEEL ELEMENTS. Walter H. Zinn, et al. (General Nuclear Engineering Corp., Dunedin, Fla.). Nuclear Power 4, No. 36, 109-11(1959) Apr.

One problem with pressurized water systems is that long-lived radioactive deposits tend to build up on the surfaces of the primary loop. When stainless steel is used in the high-flux region, cobalt-58 is the largest contributor to the activity due to (n,p) reactions on nickel. Preliminary results from a research program on the Army Package Power Reactor are presented. (W.D.M.)

12312

COMMERCIAL TANKER WITH REACTOR PROPULSION AS ALTERNATIVE. J. E. Woltjer. Schip en Werf 25, 754(1958) Dec. 12.

A project is described for the installation of a pressurized-water reactor amidships in an existing turbo-electric tanker. The object is to acquire practical experience at an early date and at relatively low cost. The conventional machinery would be retained, the nuclear installation being regarded as an alternative source for part or all of the electric propulsive power. Suitable vessels have either one or two main turbo-generators. Two particular vessels, one of each type, were studied and details are given. The vessel would be chartered, not bought. Capital expenditure is estimated at 16 million guilders; this includes 7.5 million for the nuclear plant and 3.5 million for installation and conversion work. The balance represents safety margins. The reactor would be of foreign design, but it is intended that much of the fabrication work should be carried out in Holland. (TCO)

12313

WATER TREATMENT QUESTIONS IN NUCLEAR POWER PLANTS. P. Profos. Sulzer Tech. Rev. (Switz.) 40, No. 3, 45-54(1958).

In nuclear power plants, as in modern steam power stations, water treatment is a matter of cardinal importance. While some of the problems that arise are familiar from steam engineering, there are others that are new. The principles on which the solution of such problems must be based are set forth briefly; and a survey is made, on the basis of previous experience, of the practical measures to be taken. (auth)

12314

TURBOMACHINES FOR NUCLEAR POWER PLANTS. R. A. Strub. Sulzer Tech. Rev. (Switz.) 40, No. 3, 59-70(1958).

A survey of some of the problems posed by the employment of turbomachines in reactor plants is presented. (W.L.H.)

12315

A COMPARISON OF THREE NUCLEAR POWER PLANT CONCEPTS FOR POWER GENERATION IN THE UNITED STATES. Karl Cohen and E. L. Zebroski (General Electric Co., San Jose, Calif.). p.113-31 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

Three popular current power reactor types are compared: boiling water, sodium graphite, and gas-

cooled graphite. Designs and operating parameters are described for stations of about 200 and 600 Mwe gross for each reactor. Oxide fuel is assumed except for the smaller size gas-cooled reactor which used natural uranium metal. Relative capital and operating costs are developed for the six designs. (W.D.M.)

12316

STEAM TURBINES FOR NUCLEAR POWER PLANTS. Johan A. Carlson (Westinghouse Electric Corp., Philadelphia). p.225-35 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

The various types of nuclear power reactors now under design, construction, or operation and the power recovery cycles used with these reactors are considered. Since the pressurized-water reactor cycle is the only type that thus far has been demonstrated as commercially feasible in the U. S. for large capacity, the discussion is limited to turbine designs for application with pressurized water reactor systems. Examples of steam turbine design for Shippingport, Yankee, and Indian Point are given. (W.D.M.)

12317

FIRST LARGE STEAM TURBINE FOR OPERATION WITH A BOILING WATER REACTOR. C. W. Elston (General Electric Co., Schenectady, N. Y.). p.248-57 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

A design description is presented of the 192 Mw, tandem-compound, double-flow steam turbine being built by GE for the Dresden Nuclear Power Station. The dual cycle approach is briefly reviewed, and a simplified flow diagram of the Dresden cycle is shown. (W.D.M.)

12318

HIGH FLOW RATE DEMINERALIZATION OF CONDENSATE FOR BOILING-WATER REACTORS. A. B. Sisson (Commonwealth Edison Co., Chicago), R. C. Reid (General Electric Co., San Jose, Calif.), and H. W. Frazer (INFILCO Inc., Tucson, Arizona). p.709-19 of "Proceedings of the American Power Conference, March 26, 27, 28, 1958." Volume 20. Chicago, Illinois Institute of Technology, [1958]. 783p. \$8.00.

A limit of 600 parts per billion total solids in the reactor water at Dresden, including not more than 100 ppb chloride, was established. Specific conductance of the reactor water is not to exceed 1.0 micromho per cc. Tests on various resins to attain these limits in the condensate feed water for the Dresden Power Reactor are described. (W.D.M.)

12319

ATOMIC PILES. (To United Kingdom Atomic Energy Authority). British Patent 812,544. Apr. 29, 1959.

A heterogeneous reactor core design is described, for which better heat transfer is claimed. A reflector structure within the core and another outside the core are proposed. The inner reflector is composed of a moderator plus breeder or fertile material. The outer reflector is surrounded by moderator material. (T.R.H.)

12320

IMPROVEMENTS IN OR RELATING TO HETEROGENEOUS NUCLEAR REACTORS. (To Brown, Boveri & Cie., Aktiengesellschaft.) British Patent 812,809. Apr. 29, 1959.

A reactor using gas-cooled UC spheres is described. The spheres are introduced into square channels at the top; coolant gas flows upward around the spheres. The top plate with fuel channel and coolant openings is so arranged that the coolant propels the spheres circularly until they fall into a fuel channel. The spheres are removed at the bottom by a mechanical arrangement in which one sphere at a time is pushed laterally from the bottom of the stack. Provision is included for passing coolant around the graphite core through the reflector to cool the reflector and reactor casing and regulate the temperature of the output coolant. (T.R.H.)

STABLE ISOTOPE SEPARATION

12321

AN INVESTIGATION OF TECHNIQUES FOR THE SEPARATION OF HYDROGEN AND DEUTERIUM. PART I. ZONE REFINING OF MIXTURES OF ORDINARY AND HEAVY WATER. PART II. THE REACTION OF IRON WITH MIXTURES OF ORDINARY AND HEAVY WATER. PART III. GAS CHROMATOGRAPHY WITH HYDROGEN AND DEUTERIUM SAMPLES.

Carl Owens Thomas. Thesis, Univ. of Tennessee, Knoxville, 1957. 216p.

A theoretical analysis was developed for the separation of the isotopic forms of water by a zone-refining process. The separation was experimentally confirmed but found to be much less than that predicted by the theory. The quantitative discrepancy was attributed to the very slow rate of diffusion in the water. The production of hydrogen by the reaction of Fe with various salt solutions was studied. The separation of hydrogen and deuterium by gas chromatography was investigated using a column in which the fixed phase was palladium metal supported on granular flint quartz. Displacement, frontal analysis, and elution techniques were used. (W.L.H.)

TECHNOLOGY

Raw Materials

12322

FLOTATION OF URANIUM FROM THE GOLD-URANIUM ORES OF THE WITWATERSRAND AND ORANGE FREE STATE. J. Levin (Government Metallurgical Lab., Johannesburg). p.611-44 of "Progress in Mineral Dressing."

The flotation of raw Witwatersrand ores and cyanide residues for the recovery of uranium was investigated co-operatively by workers in the U.S.A., Canada and South Africa. Generally, 20 to 30 per cent of the uranium can be floated with a frother only; the addition of a xanthate increases the recovery to 30 to 70 per cent. Some ores can be floated by oleic acid; about 80 per cent of the uranium can then be recovered in 20 per

cent weight of concentrate. Prior cyanidation generally decreases the recovery of uranium obtainable with oleic acid but work in the U.S.A. has shown that acid treatment and washing before flotation can offset the effect of the cyanidation. (auth)

12323

SOME ASPECTS OF THE URANIUM MILLING INDUSTRY. Erik Svenke (Aktiebolaget Atomenergi, Stockholm). p.647-57 of "Progress in Mineral Dressing."

The recovery of uranium from its ores is essentially a chemical leaching process and either acid or carbonate leaching are practiced according to the nature of the gangue. Acid leaching is the more commonly used, except when the gangue consists of acid-soluble minerals. Until recently, recovery from leach solutions has been by fractional precipitation but ion exchange is now the dominating process. Future developments are reviewed together with estimates made by various authorities of the quantity of uranium required in the next two decades. Some remarks are offered on the cost of production. (auth)

12324

APPLICATIONS OF SOLVENT EXTRACTION IN PROCESSING URANIUM ORES. J. Bruce Clemmer (Bureau of Mines, Salt Lake City). p.659-67 of "Progress in Mineral Dressing."

The laboratory and pilot-plant research done at Salt Lake City for the Atomic Energy Commission on the application of solvent-extraction procedures for processing uranium ores is described. The selectivities and handling characteristics of different organic extractants are described. An outline is given of the processes investigated. (auth)

12325

PROGRESS IN MINERAL DRESSING. Transactions of the International Mineral Dressing Congress, Stockholm, 1957. Einar Öhman, ed. Stockholm, Almqvist & Wiksell, 1958. 750p.

Thirty-four of the technical papers that were presented at the conference are included in this volume. The subjects covered are: classification and gravity separation; magnetic concentration, roasting, and sintering; flotation theory; flotation of sulfide ores; flotation of non-sulfide ores; and mineral processing by chemical methods. (W.L.H.)

12326

RECOVERY OF URANIUM FROM ORES. (To Commissariat à l'Énergie Atomique.) British Patent 802,452. *Platinum Metals Rev.* 3, 34(1959) Jan.

Uranium is recovered from an ore by forming, from the ore, a clear solution of a hexavalent uranyl-alkali metal or -ammonium carbonate solution, precipitating hydrated UO_2 from the solution by forming nascent hydrogen therein and separating this oxide. The nascent hydrogen is produced by subjecting the solution to electrolysis in the presence of a hydrogenation catalyst, e.g., Pt or Pd.

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